THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
Patent Law Reform	641
The Electrical Equipment of Ships of War (*illus*) (*continued*)	643
Current Specifications.—V.	644
Working Expenses of Electric and Cable Railways	646
Traction Motor Suspensions (*illustrated*) (*concluded*)	647
The Paris Exhibition	648
The "Partridge" High Tension Safety Device (*illustrated*) ...	649
Why Should London Wait?	650
Correspondence:—Tests of a Ventilating Fan	650
The Electrical Equipment of Ships of War	651
Electric Motors for Driving Grinding Stones	651
Construction of Overhead Equipments	651
Wiremen's Woes	651
The Johnson-Lundell Electric Traction Co., Ltd. (*illustrated*)	652
Business Notes	654
Dublin Electric Tramways (*illustrated*)	658
City Notes	668
Traffic Receipts	670
Stocks and Shares	670
Share List of Electrical Companies	671
Market Quotations	672
Our Legal Query Column	673
Note on the Variation, with Tension, of the Elastic Properties of Vulcanised India-rubber	673
The Mechanical Equipment of a Large Railway Station.—I. ...	674
Mean Pressure Indicator	675
Utilisation of Waste Heat	675
The Production of Light by Electricity and Gas (*concluded*) ...	676
Reviews	678
New Patents	679
Abstracts of Published Specifications	679

THE

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1900

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PATENT LAW REFORM.

"THE patent law requires amendment." Such was the *dictum* pronounced by Mr. Ritchie at the Chamber of Commerce on March 14th. Even if we were to confine ourselves to the defects in this important branch of the law which were enumerated by the President of the Board of Trade, we should be inclined to agree with him as to the need for radical reform, but, alas, in addition to these, there are many other anomalies in the existing law which we should like to see removed. In the course of his remarks, Mr. Ritchie laid special stress upon (*a*) the fact that no inquiry is made by the Patent Office, and no advice is given to a would-be patentee as to the novelty of an invention, (*b*) the undue advantages which the foreigner has in being placed upon an equal footing with a British subject. According to the report of his speech, which appeared in the *Times*, he said that both these difficulties are to be dealt with by a Commission about to be appointed for the purpose.

Dealing with the first point raised by the President of the Board of Trade, it is quite clear that the impartiality with which every trumpery invention is made the subject matter of letters patent, while it causes money to pour into the Patent Office, is a hardship to "cranks" and others who require protection against themselves. The title of the invention and the two specifications are scrutinised with the utmost care by an Official Examiner under the supervision of the Comptroller-General, with an ultimate appeal to the law officer of the Crown. Such scrutiny is exercised in order to ascertain whether the invention has received a proper title, or whether the specification sufficiently describes the nature of the invention. All questions relating to novelty or utility, *i.e.*, the very questions which concern the validity of the patent, are left severely alone, to be raised, it may be, at some future date in the course of a long and expensive lawsuit.

That novelty has ever been an essential feature of a proper subject-matter for letters patent appears from the Statute of Monopolies, which provides that the privilege of granting monopolies is preserved to the Crown only in respect of matters which can be brought under the following description:—"*Any manner of new manufactures within this realm . . . which others at the time of making such letters patent and grants shall not use.*" The novelty required must be the novelty of all that is claimed, so that to add a claim for something in a specification which is not novel may vitiate the whole patent. In the case of Gibson *v.* Brand (1 W.P.C., 631), for instance, the patent had been taken out for "a new or improved process or manufacture of silk and silk in combination with certain other fibrous substances." In their claim the plaintiffs said:—"We restrict our claims to the eight several heads of invention mentioned in the early part of this specification, all of which we believe to be new and of great public utility." On this the Cour of Common Pleas held that the plaintiffs

could not sustain their patent unless they showed that each one of the eight divisions of their process was new.

Seeing that the question of novelty is one of considerable importance, it remains to consider what alteration in the present system will be likely to reduce the number of useless patents without unduly hampering those who are content to rely upon their own judgment as to the validity of their inventions.

Patentees may be conveniently divided into three classes; (1) Those who become owners of registered patents in order that the term "patent" may be used in connection with inventions of which it would be difficult, if not impossible, to successfully maintain the utility, novelty, or ingenuity. The object of such applicants is to enhance the value of some article of commerce, for it is a well-known fact that a threat of infringement at the hands of a wealthy corporation, often compels a so-called infringer to refrain from using or manufacturing a "patented" article. (2) In the second class may be placed the *bonâ fide* inventors who seek to protect an invention, of which they appreciate the true value. (3) The third class comprises those who take out a patent in the simple belief that it is novel, and who therefore believe that they are entitled to the benefit of the patent laws, framed, as they are, to encourage ingenuity and to secure to the inventor some substantial profit. Allowing that to use the Patent Office for merely commercial purposes, is in accordance with the spirit of the patent law, it is clear that proprietors of commercial patents should be placed in a different category from those who imagine that the right to attach the magic insignia of the Patent Office to their invention confers an indisputable right to make, use, and vend the article within the realm. Thus the *bonâ fide* patentee, coming forward as the discoverer of a really valuable invention to obtain well-merited protection, would find it hard to have his patent defeated by the decree of an official at the Patent Office to the effect that it was not new, or that for some other reason was not the proper subject matter for a patent. Any modification of our present system of patent law must safeguard the interests of such inventors.

With regard to the third class of inventors to which we have alluded, the suggestion made by the President of the Board of Trade, namely, that the officials of the Patent Office, or some specially appointed official, should be prepared to advise the patentee as to the novelty of his invention, has much to commend it. In the first place, many an inventor would hesitate to incur the expense of a patent if it was made clear that his ingenuity had been forestalled. In the second place, no inventor could be heard to say that he had obtained a grant in blissful ignorance that his invention was no novelty.

The fact that foreigners are practically upon an equal footing with British subjects in relation to the grant of letters patent has long been a serious grievance. Thus a patent granted to a British subject in his own name for an invention communicated to him by a foreigner, the subject of a State in amity with this country, is not void, although such patent is in truth taken out and held by the grantee in trust for such foreigner [Beard *v.* Egerton, 3 C.B. 97; 15 L.J., C.P., 270; 10 Jur. 643]. Moreover, letters patent may be granted to an alien resident abroad for an invention communicated to him by another alien also resident abroad. [Worth's Patent, *In re*, 12 Ch. D. 303; 28. W.R. 329; see also Patents Act, 1883, Section 4]. Seeing that a foreigner who holds a grant of letters patent in this country has the power of granting or withholding licenses which is vested in every patentee, it is not difficult to understand the dangers to which this state of the law may give rise.

It is said, indeed, that the backward state of the manufacture of dye-stuff in this country is largely due to the fact that many of the valuable patents for these products are held by foreigners who, by refusing to manufacture or grant licenses for the manufacture of the dyes in this country, manage to confine the output of aniline dyes to foreign factories.

While the reform of the law relating to letters patent is under discussion, it may be well to advert to certain other serious defects which have shown themselves in recent years. As is well known the Board of Trade may order a patentee to grant licenses on such terms as it may think fit, and any such order may be enformed by mandamus. [See Patents Act, 1883, Sec. 22.] For the purposes of deciding whether the patentee shall grant more licenses, the Board of Trade appoint an assessor to hear both sides, and advise the Board whether the patentee should or should not be compelled to grant further facilities. The expense of the proceedings and the unsatisfactory nature of the tribunal has well nigh rendered the 22nd Section of the Patents Act a dead letter.

Another serious evil in connection with licenses has shown itself. It seems that there is nothing to prevent a patentee from granting a license subject to conditions compelling the licensee to use the invention only in connection with other articles manufactured by the patentee. By this means the patentee is enabled to sweep into the net of his monopoly a number of articles, and compel the licensee of his patent, and eventually the purchaser thereof, to buy at what may well be an exorbitant price, some article which has little or nothing to do with the subject matter of the patent.

We do not say that many cases of this kind have come before our notice, but the right exists nevertheless. Thus in the Incandescent Gas Light Company, Limited, *v.* Brogden [1899, 16 R.P.C., 179], the company were owners of two patents for incandescent gas mantles. Each mantle sold by the company was placed in a box with the following limited license printed upon it:—"The Incandescent Gas Light Company, Limited, in supplying the mantle contained in this box, grant a limited license to the purchaser to use and sell the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use with burners sold or supplied by the company, and any other sale or use will amount to an infringement of the company's patent." The company supply mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the limitations above set forth. The alleged infringement by the defendant was the sale of a mantle for the purpose of use with a gas burner, not sold or supplied by plaintiff company. In the course of his judgment Mr. Justice Kennedy said:—"A patentee has a right not merely by sale without reserve to give an unlimited right to the purchaser to use, and thereby to make in effect a grant from which he cannot derogate, but may attach conditions, and if those conditions are broken then there is no license, because it is bound up with the observance of the conditions." Admitting for the moment that Mr. Justice Kennedy's judgment is correct (for is it not a question that such a user of his grant is "either prejudicial or inconvenient to our subjects in general" within the proviso contained in the grant?) it is readily apparent that the powers declared to be vested in the patentee are of wide extension, and capable of being used by him in an arbitrary manner. Suppose, for instance, the owner of a valuable patent, much sought after by, if not essential to the welfare of, the public, chooses to impose onerous or impossible terms upon the purchasers. The present law appears to provide no remedy in such a case, with the exception, possibly, of a petition for revocation. It is hoped that in addition to the reforms suggested by the President of the Board of Trade, the evils to which we have ventured to refer will be dealt with by the Commissioners and subsequently embodied in an Act to amend the law relating to letters patent.

THE ELECTRICAL EQUIPMENT OF SHIPS OF WAR.*

(*Continued from page* 609.)

The problem of maintaining communication between the several compartments, cabins, and military positions in a warship is not less important than the problem of maintaining general illumination, but it is far less successfully solved. As regards the communication between officers in their cabins and their subordinates and sentries, a simple system of bell signals with annunciators or "shutters" is all that is required; but communication between the navigating officers on the bridge and the engine rooms, and between combatant officers in the conning tower and the gun and torpedo stations, for example, may often be of a much more complex and special character than can be easily given by a simple code of bell signals. Beyond a certain point means of verbal or telegraphic communication becomes necessary.

The connections between stations are effected by four-core cable, the conductors being 1/16, separately insulated with rubber, and covered with different coloured cotton coverings to facilitate making and tracing connections. The electrical connections of a pair of instruments are given in fig. 9.

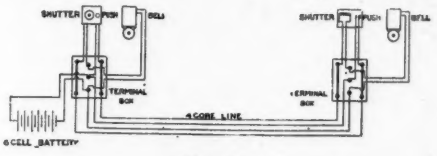

Fig. 9

When, as is usual, several pipes and instruments occur at the same station, all the branching and jointing is done in terminal boxes. One bell is usually fitted common to the group, and one six-cell battery supplies several groups, the connections being made through suitable battery terminal boxes. The whole system is watertight, and no jointing of wires is done outside boxes.

It has been usual in recent years to insulate carefully the tubes from the main structure of the ship, so that they shall not pick up sounds by conduction, and the device has been employed of leading the speaking tubes to about six exchange stations where messages are received and transmitted, so that the length of tube spoken through between point and point is reduced to the smallest limits. There is much,

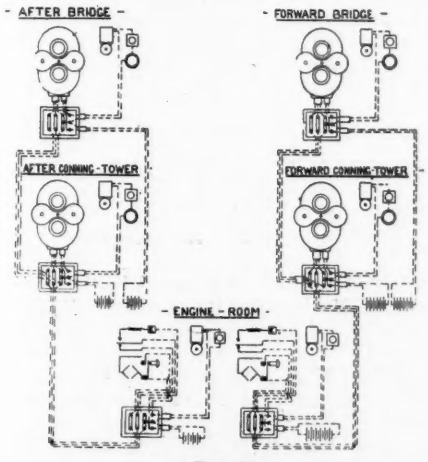

Fig. 10.

however, still remaining to be done in the solution of the problem of communication.

The failure of voice tubes has given telephones their opportunity, the speaking qualities of the latter being practically independent of distance. One of the best forms of naval telephone, and one that is now being largely used, not merely by the British, but by many other navies, is Alfred Graham's. It is a loud-speaking instrument, the transmitter taking the current of four or six large agglomerate Leclanché cells, and operating without an induction coil. The transmitter is of granular type, enclosed in a watertight case. It is turned half round, every time the telephone is used, by the switch which puts the line connections from "ringing" to "speaking." In spite of the large power employed there is no hissing. The receiver is contained in the same case. Telephone connections in a typical case are shown in fig. 10.

What seems to be wanted is a system of printing telegraphs, the instruments being of a not too sensitive character, so that they could work without giving false signals due to vibration and shock, the general design of the instrument being somewhat after the fashion of that used by the Exchange Telegraph Company, printing in ordinary Roman letters. Such an instrument would have a relatively slow speed of action, but its result would be more positive, inasmuch as the message could be read by a person without a telegraphic training, and if by chance a false letter were printed, it would not necessarily prevent the word from being recognised.

It may be mentioned that steps are being taken to introduce into the Navy the "Sullivan" galvanometer for enabling ships at sea to speak with the land through ordinary submarine cables. There is some prospect also that warships will make general use of the Marconi telegraphic apparatus for fleet and ship-to-shore communications.

Gun and Torpedo Work.

Electricity is an indispensable adjunct to the armament of a man-of-war, being invariably used for discharging torpedoes and for firing modern breech-loading guns of all sizes. While all other circuits in the ship are twin wired, gun and torpedo circuits are now universally single wired.

In the original paper diagrams are given of torpedo and gun-firing circuits as used in connection with Elswick equipments.

Range Finders.

These are sometimes electrical. That used by the United States Navy, invented by Lieut. Fiske, is based upon the Wheatstone bridge principle. Two telescopes (fig. 11) are

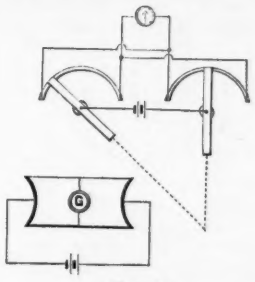

Fig. 11.

mounted so as to move over graduated arcs. In gear with the trains of movement are cylinders wound with resistance wire. When the telescopes are parallel, these resistances form balanced arms of a Wheatstone bridge. When the telescopes are trained so as to bring a distant object into the field of both simultaneously, the electrical balance is upset and current flows in the galvanometer to an extent depending upon the arc of training, which is a trigonometrical function of the distance of the object from the centre of the base line connecting the two telescopes. The base line should be as long as possible, whence one instrument is usually mounted on the forward bridge, and one aft, the galvanometer being in the conning tower where the firing keys are placed. It is necessary to know this base line with great accuracy, or errors creep into the range. Further, three observers are necessary, who must be connected with each other by telephone. The method is a delicate one, and the difficulty of making the necessary adjustments, taken in conjunction with the difficulty of using the telephones during gun-firing, led, it is said, to the abandonment of the apparatus by the vessels engaged in the war with Spain, who found it easier to get the ranges by trial shots.

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* Condensed from a paper read by Mr. C. E. Grove at the Institution of Electrical Engineers, April 5th, 1900.

foreigner who holds a grant of letters patent in this country

relating to letters patent.

The range-finder used in the British Navy, and which has also been supplied to most foreign navies, is that of Barr and

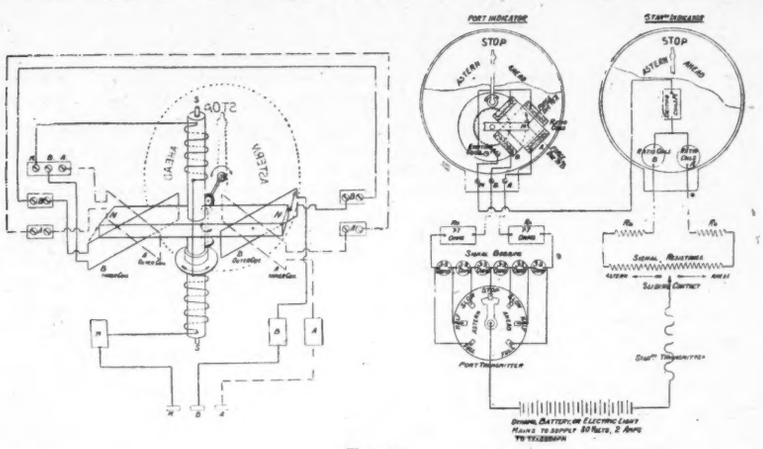

Fig. 12.

Stroud. It is designed for use by a single observer, but being a purely optical instrument, does not call for detailed description here.

The ranges having been found, the next step is to transmit them to the various gun stations. For this purpose Drs. Barr and Stroud have invented a system of "range and order telegraphs" for indicating simultaneously at any number of stations the range of a given object, together with information as to the guns which can be brought to bear upon it, and orders as to firing. The British Admiralty have them on trial.

Engine Room Communication.

An electric system of engine room reply telegraphs, worked out by Messrs. Richards & Evershed, was fitted in H.M.S. *Howe* and *Narcissus* in 1893, and since then in other British war vessels. The indicating instruments have the appearance common to mechanical telegraphs, the dials being marked to show the usual direction orders—"Stop," "Slow," "Half," and "Full," "Ahead," or "Astern." The revolution of the indicating hand is effected by the combined operation of two electro-magnets (see fig. 12) placed at right angles to one another, and producing between them a cross magnetic field, within which lies a magnet with which the indicating needle is geared. The position of the needle depends solely on the relative strength of these two field components, and this depends on the ratio of the current in the two coils. This ratio is controlled by the "transmitter," which consists of a multiple contact switch, through which the ordinary 80-volt electric light circuit is connected to a pair of ratio arms included in the same circuit as the coils of the indicator; the movement of the transmitter, switches resistance out of one arm into the other, thus altering the relative value of the current strength in them, and controlling the movements of the indicator. An important detail is that the action does not depend on the absolute value of the currents in the indicator coils, but only upon their relative value, so that a constant voltage is unnecessary. A similar indicating instrument, graduated in degrees, is used for showing, at the several navigating stations, the angle made by the rudder, the transmitter switch in this case being automatically worked from the rudder crosshead.

A system for showing simultaneously in the bridge positions, conning towers, and other navigating stations, the revolutions of each set of engines, and for indicating in each engine room the revolutions made, not only by the set of engines in that room, but also by the set in the other room, is of great value. Such a system has been worked out by Signor P. Molinari, and has been adopted throughout the Italian Navy, and is also used on warships of other countries. The indicating instruments are direct reading in revolutions per minute. They are clockwork instruments, kept in synchronism by a standard clock. This standard clock has a commutator within it which sends current for 20 seconds into the coils of an electro-magnet in the indicating instruments, then breaks it for 4 seconds, re-establishes it for another 20 seconds, and so on. While this current is on, the electro-magnet holds a detent which allows an escapement motion to drive the indicating hand over the dial. Correcting currents sent by a revolving contact-maker driven by a friction wheel from the propeller shaft of the engine at the rate of three per revolution are received in separate electro-magnet coils in the instrument, and while the main current, controlled by the standard clock, is disturbed for the 4-second interval mentioned, the correcting currents drive the indicating needle forward or pull it backward according as the average rate of revolution of the engines has been less or greater than that shown at the moment on the dial of the instrument. A galvanometer tell-tale for indicating "ahead" or "astern" is fixed in the bottom of the indicator case, and receives current from what is called by the inventor an "alternator," driven from the shaft in one direction or the other according as the ship is going ahead or astern. When no current passes at all the needle takes the mid position and indicates "stop."

(*To be continued.*)

CURRENT SPECIFICATIONS.

V.—BIRKENHEAD TRAMWAY ELECTRIC POWER GENERATING STATION.

Summary.

Plant Required.—Three steam dynamos for traction work.

Output of Engine.—360 I.H.P., with steam at 140 lbs. pressure, and working condensing with vacuum of 24 inches in exhaust pipe close to engine.

Output of Dynamos.—409 amperes at 550 volts when working as compound-wound machine = 225 KW.; 375 amperes at 600 volts when working at same speed as simple shunt machine = 225 KW.

Speed Specified.—350 revolutions per minute.

Specified Date of Completion.—Ten months from date of order, or if later date, two months from completion of buildings and foundations.

Penalty for Late Delivery.—£40 per week or each fraction of a week.

Stipulations as to Wages paid to Workmen.—None.

Stipulations as to Removal of Foreman.—Unsatisfactory. See comments below.

Arbitration.—Satisfactory.

This specification has been prepared by the borough electrical engineer, Mr. William Bates, A.M.I.C.E., and affords another instance of the tendency on the part of municipal authorities to rely more and more on the advice of their permanent officials, and to entrust to them the consulting work necessary in all extensions of an existing undertaking.

At the present time, when there is so much new work in prospect, the outlook need not alarm the consulting engineer, but the time must come, if the present prevalent practice is continued, when the number of new undertakings in progress will be comparatively few, and the calls upon the services of members of the consulting profession correspondingly limited.

Three 225-KW. steam dynamos are asked for, the type of engine being practically limited to those designed to give this output at 350 revolutions per minute. We think that this plan of specifying *one definite speed*, and not allowing

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found it easier to get the ranges by trial shots.

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tenderers the option of offering standard designs is open to grave objection. If the speed mentioned happens to be the standard speed of any well-known type of plant, an impression is likely to be formed that there is a preference for that make of plant. It is far better if a speed is mentioned as a limiting speed, and permission thus given for manufacturers to compete on an equal basis, with standard types of plant.

Tenderers will also do well to note that at the normal speed of 350 revolutions the output of the dynamos may be either 409 amperes at 550 volts or 375 amperes at 600 volts, while for periods of *one hour* it must be capable of giving 492 amperes at 530 volts. The maximum current to be allowed for in the design of the machine, is therefore 492 amperes, and the maximum pressure 600 volts, or an output of 295·2 KW.

The specification demands that detailed drawings, and also a number of particulars of design, shall be sent in *with the tender*. Thus Clause 67 reads :—

The contractors *shall send in along with their tender* a *complete set of drawings* to a suitable scale showing the construction and leading dimensions of the dynamos which they propose to supply; also *a statement of the resistance of the field magnets and armature windings, and of the qualities of the iron employed and a description of the insulation used in the different parts, together with copies of the internal and external characteristic curves of the machines at various speeds.*

No alteration shall be made in the construction, dimensions, resistance, &c., of the dynamos as shown by these drawings and statements, except with the consent of the engineer in writing, and drawings and descriptions of all such alterations shall be sent to the engineer.

Compare this clause with the following drawn up at the conference between the committees of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association in relation to same subject.

The *contractor* shall at his own expense supply to the *purchaser* copies of the drawings necessary for the erection of the works under the contract, but shall not be called upon to furnish constructional details further than in the opinion of the engineer are required for the purposes of the contract. If the contractor shall be called upon to supply additional copies of the drawings, they shall be paid for at a fair price to be arranged. The engineer shall, in addition, have the right at all reasonable times to inspect any drawings of any portion of the plant contracted for at the works of the manufacturer.

Here the rights of both contractor and purchaser are safeguarded. *After the contract has been awarded*, the engineer is given all reasonable facility to enable him to satisfy himself that the plant supplied is suitable for the purpose required, and on the other hand, the contractor is protected from giving to possible non-purchasers technical and constructional information which might enable others to copy his designs.

We are strongly of opinion that any demand of this character for detailed technical information to be sent in *with the tender* should be refused by tenderers, assurances being given that as soon as the contract is finally given out no reasonable request on the part of the engineer to the successful contractor for technical and constructional details shall be refused.

The clauses relating to the rights of the purchasers in case the plant fails on test to reach the specified efficiencies are very stringent and, in some respects, unfair.

Thus we read in Clause 49, in respect to the engine :—

The Corporation, by their engineer, shall have the right to reject any engine if the mechanical efficiency shall be found, either during the tests at the maker's works or at the subsequent test after erection at Birkenhead, to be less than 89 per cent.; also to reject any engine whose steam consumption is greater than 18 lbs. per indicated horse-power per hour at three-quarter load, or whose governing is not with the limits specified in Clause 47.

In the event of such rejection, the contractors shall immediately remove the engine, if already erected, and shall, if the Corporation so require, *supply a new engine in the place of the one so rejected.*

Should, however, *the Corporation require the rejected engine for their immediate use, they shall have the right to keep it and work it free of all charge for hire until the new one to be supplied in its place shall have been erected, tested, and accepted.*

Similarly in Clause 71, regarding the dynamo :—

The Corporation, by their engineer, shall have the power to reject any dynamo if the commercial efficiency falls below that specified in Clause 69, or if it fail to pass the test for rise of temperature, and the contractors shall, if the Corporation so require, immediately and with all diligence provide a new dynamo to replace the one so rejected.

The Corporation, by their engineer, reserve to themselves the right of accepting the dynamo should it have failed to pass the specified tests, subject to the following deductions:—

A reduction of 3 per cent. on the schedule price of the dynamo for every 1 per cent. less than the specified efficiency of 93·5 per cent. A deduction of £2 (two pounds) for every degree Fahrenheit rise in temperature beyond the specified maximum rise.

The Corporation, by their engineer, *further reserve to themselves the right of keeping and using a rejected dynamo free of charge until the one which is to replace it has been mounted, tested, and accepted.*

These clauses, read in conjunction with Nos. 20 and 22, are not just, for in Clause 22 we find that—

The work shall not be deemed finished or complete until the same shall have been certified in writing by the engineer to that effect.

And in Clause 20, which deals with penalty—

In default of completion within the period named, or such extended period as may have been granted, the contractors shall forfeit and pay to the Corporation by way of liquidated and ascertained damages, and not by way of penalty for such non-completion, a sum of £40 per week for each and every week or fraction of a week during which the work shall remain uncompleted after the expiration of the period named, such weekly sum to be payable on demand, or (at the option of the Corporation) deducted and retained by the Corporation from any moneys in their hands due or to become due from them to the contractors.

If the contractors shall fail in any of the tests, or shall not have completed the work within the period specified, *the Corporation shall be at liberty to use such part of the work as may already be delivered without either taking it over or making further payment until the tests shall be satisfactorily complied with and the work be properly executed and completed.*

It will thus be seen that the Corporation reserves the right not only to employ plant which may be quite suitable for use but slightly less efficient than demanded by the specification, free of charge, but also it gives no undertaking that penalty shall not accrue during the period in which plant is in beneficial use. The contractor therefore might, if the letter of the specification were insisted upon, supply an engine and dynamo which was rejected, and then be called upon :—

(*a*) To supply a new engine and dynamo.

(*b*) To permit the existing plant to be used by the purchaser free of all cost while the new set was being manufactured.

(*c*) Pay £40 per week as penalty or fine for non-completion during the time the new set was being made.

We think it would be only just either to suspend the operation of the penalty clause under these circumstances, or to pay the contractor for the hire of the rejected set while in use, a sum representing the benefit of the set to the Corporation, had it met all the requirements of the specification.

There are two other clauses which might bear unfairly upon the contractor, thus in speaking of the powers of the engineer in Clause 9, it says :—

The engineer shall have at all times access to the work, *which shall be entirely under his control;* he may, if he deem it necessary, require the contractors to remove from the work any person engaged thereon who is in the contractors' employ who is incompetent or misconducts himself, and the contractors shall forthwith comply with such requirement.

The objectionable sentence being that printed in italics, and in the maintenance clause, No. 14, it puts the onus of proving that a defect is not due to faulty workmanship or materials upon the *absent* contractor, whereas it should in fairness be for the purchaser whose representative uses the plant to prove that the fault is due to some defect in the plant.

The clause reads thus :—

The contractors shall maintain and uphold the work in an efficient manner for 12 calendar months after its completion shall have been certified in writing by the engineer, and then hand over the work in a sound and perfect condition, and *the contractors shall take risk of and be answerable for all accidents and damages to persons or things that may occur during the progress and until the expiration of* 12 *calender months after the entire completion of the work*, and shall repair and make good the same from time to time at their own cost and charge, and shall indemnify the Corporation against any charges or costs respecting the same, *unless they can satisfy the engineer that the defect is due to some known cause other than defect of construction, workmanship, and material.*

re-establishes it for another 20 seconds, and so on. While this plan of specifying *one definite speed*, and not allowing

WORKING EXPENSES OF ELECTRIC AND CABLE RAILWAYS.*

Herewith we present the tables of working expenses, receipts, &c., of the electric and cable elevated and underground railways (for which figures are available) down to date. As in previous years these tables show the results from the time of the opening of the lines, and they are of much interest to those concerned in the financial aspects of such railways. The following are the figures for Liverpool:—

Table I.—Liverpool Overhead Electric Railway.

Per Train Mile—Pence.

Half-year.	Maintenance of way, works, and stations.	Locomotive power.	Car repairs and renewals.	Traffic expenses.	General charges, taxes, &c.	Total expenses.
June, 1893 (17 weeks)	...	4 00	...	7 05	4 36	15·41
Dec., 1893 ...	1 09	4 03		5 32	2·48	12 92
June, 1894 ...	1·13	2 88	·38	5 68	2·89	12 96
Dec., 1894 ...	1·22	3 25	·18	5·09	2 58	12·32
June, 1895 ...	1 44	3 49	·21	5 4	3 05	13 59
Dec., 1895 ...	1·81	3 68	13	4 99	2 61	13·22
June, 1896 ...	1·89	3·4	·22	5 44	3 23	14·18
Dec., 1896 ...	2·1	3 68	·4	5 46	3·05	14 69
June, 1897 ...	1·8	3 42	·29	5 41	3 26	14 18
Dec., 1897 ...	2 16	3 71	·38	5 12	3 44	14·81
June, 1898 ...	1 89	3 93	·46	5 59	2 74	14·61
Dec., 1898 ...	2·14	3 91	·53	5 57	2 77	14·92
June, 1899 ...	1 8	4 31	·46	5 79	2 74	15·1
Dec., 1899 ...	1 29	4·17	27	5 4	2·58	13·71

Table II.—Liverpool Line—Totals.

Half-year.	Expenses per train mile.	Receipts per train mile.	Per. cent. of expenses to receipts.	Total expenses.	Total receipts.	Miles run.	Passengers carried.
June, 1893 (17 weeks)	d. 15·41	d. 27·23	56·59	£ 6,990	£ 12,352	108,850	1,370,742
Dec., 1893...	12 92	18 07	71·5	13,108	12,342	243 589	2,475,639
June, 1894...	12·96	18·1	71 6	14,322	20,012	265,349	2,861,437
Dec., 1894...	12 32	19 59	62 89	16,137	25,675	314,472	3,641,379
June, 1895...	13 59	21·65	62·77	17 629	28,082	311,346	3 460,060
Dec., 1895...	13 22	23 53	56·18	17,694	31,508	321,417	3,780,375
June, 1896...	14·18	23 95	59 21	18,494	31,236	313,010	3 739 575
Dec., 1896...	14·69	24 51	59 93	19,654	32,783	320,993	3,919,134
June, 1887...	14·18	23·79	59 6	21 459	36,026	363,399	4,269,260
Dec., 1897...	14·81	24 25	61 07	22,940	37,559	371,773	4,467,490
June, 1898...	14·61	24·63	59 32	22,076	37,220	362,690	4 472,941
Dec., 1898...	14 92	26 12	57·12	23,218	40,656	373,560	4,894,921
June, 1899...	15·1	23·32	64 75	23,624	36,492	375,500	4,475,279
Dec., 1899...	13·71	25·42	53 93	25,007	42,662	402,752	5,214,957

The working expenses in Liverpool over the whole of last year compare not unfavourably with several previous years, and the company are to be congratulated on the economies which have made this result possible. A glance at the tables will show the considerable increase in the charge for locomotive and generating power per train mile, and that this has only been compensated by the saving under other heads. The high cost of coal and other supplies for the generating station during the year explains the increase under this heading. The decrease in the receipts per train mile in the first half of the year was attributed to the extension of time during which workmen's return tickets are available, and to a decrease in the number of first class passengers owing to the competition of the ever-extending electric tramways. A considerable recovery took place in the receipts during the second half of the year, and this coupled with the diminution in the working expenses, produced a ratio of expenses to receipts of only 53 93 per cent., which is the best showing in this column since the railway was opened, and brings the percentage down almost to the level of that of the Glasgow Subway. The expansion of the company's business is shown by the total receipts, the miles run, and the passengers carried is highly gratifying.

* *Tramway and Railway World.*

Passing on, the following are the tables for the City and South London line:—

Table III.—City and South London Electric Railway.

Per Train Mile—Pence.

Half-year.	Maintenance of way, works, and stations.	Locomotive power.	Car repairs and renewals	Traffic expenses.	General charges, taxes, &c.	Total expenses.
June, 1891 ...	·53	9·06	·5	8 82	2 44	21·35
Dec., 1891 ...	·63	7·89	·46	8 1	2 66	19·74
June, 1892 ...	·56	7 67	54	7·52	2 89	19·18
Dec., 1892 ...	·43	7·11	·47	6 78	2·44	17·23
June, 1893 ...	·5	6·48	·53	6·39	2 6	16 5
Dec., 1893 ..	·6	6 23	·46	6 17	2·35	15 81
June, 1894 ...	·59	6 22	·41	6 08	2 52	15·82
Dec., 1894 ...	·55	6 03	·37	5 94	2 47	15 36
June, 1895 ..	·56	6 1	·45	6 29	2 67	16 07
Dec., 1895 ...	·49	6 02	·48	5 98	2·48	15·45
June, 1896 ...	·7	5 8	·56	6 21	2 69	15 96
Dec., 1896 ...	68	5·64	55	6 03	2·58	15·48
June, 1897 ...	·59	6 11	·57	6 25	2 7	16·22
Dec., 1897 ...	·62	5 83	·48	6·18	2·65	15 66
June, 1898 ...	76	5·85	·56	6 03	2 72	15 92
Dec., 1898 ...	83	5·65	·56	6 17	2 67	15·88
June, 1899 ..	·79	5·85	·48	6·14	2 91	16 17
Dec., 1899 ...	·67	5·85	·48	6·09	2·75	15 84

Table IV.—City and South London Line—Totals

Half-year.	Expenses per train mile.	Receipts per train mile.	Per cent. of expenses to receipts.	Total expenses.	Total receipts.	Miles run.	Passengers carried.
	d.	d.		£	£		
June, 1891...	21·35	27·02	79·02	15,521	19,637	174,435	2,412,343
Dec, 1891...	19 74	25 75	76·66	15 516	20,244	188 666	2,749,055
June, 1892..	19·18	27·33	70·18	15,098	21,520	188,944	2,813,162
Dec, 1892...	17 23	25 36	67·94	15,390	22,653	214,417	3,217,602
June, 1893..	16·5	25 54	64 6	14 964	23 159	217,664	3.146,656
Dec., 1893...	15 81	24·44	64 68	14,762	22,821	224,101	3,093 351
June, 1894...	15·82	25·6	61·8	14,990	24,295	227,363	3,383,154
Dec., 1894...	15·36	25 24	60 86	14,762	24,253	230,604	3,275,649
June, 1895...	16 07	26 11	61·55	15,020	24,402	224,259	3,113,199
Dec., 1895..	15·45	25 92	59 61	14,639	24,554	227,350	3,172,438
June, 1896...	15 96	26 5	60·23	15,002	24,911	225,554	3,192,672
Dec., 1896...	15·48	27·25	56 81	14,930	26 282	231,489	3,368,480
June, 1897...	16·22	29 15	55·64	15,734	28,260	232,703	3,437,810
Dec, 1897...	15 66	27·63	56 68	15,035	26,528	230,396	3,337,861
June, 1898...	15·92	28 1	56 65	15,614	27,552	235,342	3,478,977
Dec., 1898...	15 88	28 28	56·15	15,498	27 588	234,166	3,462,814
June, 1899...	16·17	28 69	56·36	15,851	28,125	235,254	3.540,098
Dec., 1899...	15 84	26·87	58·95	15,968	27,506	241,973	3,442,942

The cost of fuel does not seem to have had any material effect on the expenses during the past year, and the totals per car mile show a wonderfully even record. As to the receipts, the company, like Liverpool, have to complain of increased tramway competition. In London, however, this does not arise from the adoption of electric traction on the tramways, but from the reduction to almost incredibly low figures of the fares charged by the London County Council. When the Council's tramways are worked electrically the competition will be still more severe. The company, however, are now entering on a new phase of conditions, which is bound to tell a good deal in their favour. This is the increasing length of their railway. The extension from King William Street to Moorgate Street has recently been opened, the southern extension to Clapham is nearly ready for traffic, and the prolongation northwards from Moorgate Street to Islington is under way. When all is complete the company will have a through route between south and north London with which no tramways can compete. The competition for short distance travel south of the Thames will continue; but, on the other hand, the increased length of the line has obliged the company to abandon the (with slight exceptions) uniform fare for any distance, and to adopt graded fares proportioned to the distance. Even now these fares are in some cases at least higher than those on the tramways, but, of course, the company offer greater speed, protection from disagreeable weather, and a uniform temperature which feels warm in winter and cool in summer. Further benefits will

any dynamo if the commercial efficiency falls below that specified in Clause 69, or if it fail to pass the test for rise of temperature, and *defect is due to some known cause other than defect of construction, workmanship, and material.*

arise from the interchange of traffic at the Bank of England with the Waterloo and City Railway and the Central London Railway. As in the case of Liverpool, the totals of receipts, miles run, and passengers carried were for the past year the highest on record. The drop in receipts during the second half of the year has, however, brought the percentage of expenses to receipts up to nearly 59.

Next come the tables for the Glasgow Subway (where cable traction is used) :—

TABLE V.—GLASGOW DISTRICT SUBWAY.

Per Train Mile—Pence.

Half-year.	Maintenance of way, works, and stations.	Locomotive power.	Car repairs and renewals.	Traffic expenses.	General charges, taxes, &c.	Total expenses.
July, 1897 ...	·88	2 14	·35	1·63	·74	5 74
Jan., 1898 ...	·7	2 99	·39	1·85	1·22	7·15
July, 1898 ...	·76	3·0	·4	2·08	·94	7·18
Jan., 1899 ...	·83	3·02	·41	2 08	·79	7·13
July, 1899 ...	·82	3 16	·24	2·47	·99	7 68
Jan., 1900 ...	·75	3 08	·23	2 57	1·3	7 93

TABLE VI.—GLASGOW LINE—TOTALS.

Half-year.	Expenses per train mile.	Receipts per train mile.	Per cent. of expenses to receipts.	Total expenses.	Total receipts.	Miles run.	Passengers carried.
	d.	*d.*		£	£		
July, 1897	5·74	12·01	47 79	12,205	25,541	510,161	4,178,215
Jan., 1898	7 15	12·98	55 08	16,492	29,937	553,307	5,450,177
July, 1898	7 18	14·44	49·72	16,247	32,682	543,114	5,779,119
Jan., 1899	7·13	15·54	45 88	16,474	35,925	554,770	6,666,082
July, 1899	7 68	15 78	48 67	17,520	35,977	547,083	6,505,221
Jan., 1900	7 93	16 2	48 95	18,471	37,744	558,961	7,150,342

The increases during the past year in some of the items of expenditure are largely due to higher rates of wages and dearer coal. The result is a considerable rise in the total expenses per train-mile. On the other hand, there has been some increase in the revenue per train-mile, though not enough to prevent the percentage from rising slightly above that for the half-year ended January, 1899. Even now, however, it compares favourably with the ratio of expenses to receipts on the Liverpool and London lines. It is gratifying to note that in spite of the fierce competition by tramways, the total receipts, miles run, and passengers carried show an increase. The tramway competition is more effective than in Liverpool and London, because the Subway has a circular route, so that the distance between given points is often shorter by tramway than by railway. Hence in such cases the subway does not get the benefit of its higher train speed, while the shorter distance on the tramway must also often mean a lower fare.

In making any comparison of the results obtained on the three lines, the difference of conditions which are set out in the following table should be borne in mind :—

TABLE VII.

	Liverpool Overhead.	City and South London.	Glasgow Subway.
Number of cars in train	2	3	2
Passenger accommodation (seated)	114	96	66
Weight of train, empty	31 tons	31 tons	13½ tons
Weight of train, all seats occupied	38 tons	37 tons	18 tons
*Receipts per passenger carried	1·96d.	1 92d.	1 26d.
Length of railway (double track)	6¼ miles	3 miles	6¼ miles
*Train miles run per double-track mile	59,666	80,598	82,809
*Passengers carried per double-track mile	772,956	1,147,647	1,059,310

*In last half-year.

An attentive examination of this table in the light of the tables given before will yield some interesting information, especially as showing the wonderful work the Glasgow Subway is doing. If its receipts per passenger approached those in London and Liverpool it would pay very large dividends. But the fares are very low, and as the route is circular much of the travel is for very short distances. Taking the percentages of expenses to receipts in the previous tables, it will be seen now that the Glasgow expenses are only about a halfpenny per passenger, while those of London and Liverpool are about a penny. (The receipts per passenger are in each case rather more than the average fare as miscellaneous receipts are included.) Glasgow runs the largest number of train-miles per mile of track, but its train is the smallest.

TRACTION MOTOR SUSPENSIONS.

By ERNEST KILBURN SCOTT, A.M.I.C.E.

(*Concluded from page* 605.)

PART II.—GEARLESS MOTORS.

Mr. S. H. Short was one of the first to advocate the "gearless motor"—that is, the motor directly on the axles. An early form is shown in fig. 11, and it is interesting to

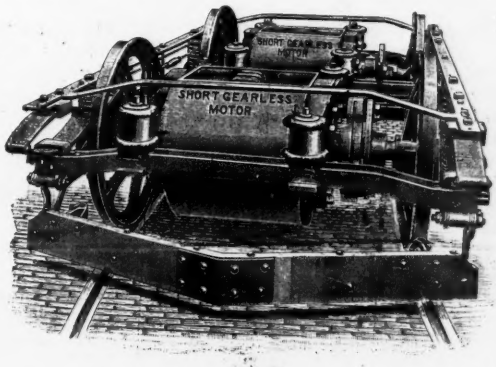

FIG. 11.

notice that in this case the motor framework is suspended *around*, but not *on* the axle, the weight of the field castings being taken by four buffer springs. In order to allow for relative movements of the field and the armature, the latter was of the flat disc pattern with Gramme winding, the poles being on either side, as in a Victoria dynamo. In this way

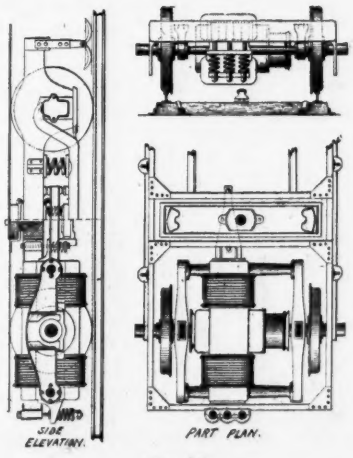

FIG. 12.

slight vertical movements did not matter, but it was important that there should not be any end-play. The jerk at starting and stopping was taken by four sets of tangential springs attached to the armature sleeve.

* *Tramway and Railway World.*

warm in winter and cool in summer. Further benefits will

This form was soon given up for the drum armature, which, of course, necessitated that the field casting should move with the axle. Thus we get the almost universal method shown in figs. 12 and 13, which are details of the Liverpool Overhead and the City and Waterloo Railways respectively.

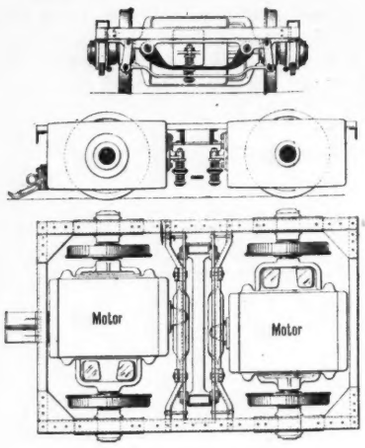

Fig. 13.

Although carried direct on the axle, the field casting is able to give slightly at starting, stopping, &c., by compressing the suspension springs, which are usually provided. These springs, by the way, are not always of the spiral type. Fig. 14, for example, shows the truck and six-pole motors for the Baltimore electric (tunnel) locomotive, and in this case the springs are of the laminated or carriage type.

Although so extensively used, this method of having *four bearings* on the axle—two for the axle boxes and *two for the motor*—has always struck the writer as being wrong in principle, because the actual movement of the motor field casting is very slight indeed, being merely that due to the compression of the suspension springs. It seems a pity, therefore, to go to the expense of two extra bearings on the axle if they can be dispensed with, and the writer suggests that this may be done by the employment of cannon bearings as shown in fig. 15. In this case the motor casting does not

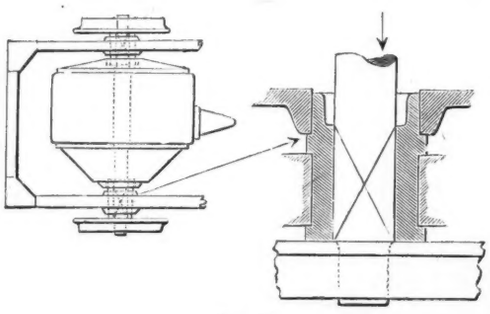

Fig. 15.

rest on the axle at all, but is supported on projections forming part of the axle boxes. When an obstruction is met with, the axle lifts slightly, carrying with it the axle box and so also the motor frame, so that all the parts are kept in true alignment. As there is very little motion, the projections from the axle boxes do not require to be proper bearings with elaborate provision for lubrication; they need be little more than supports. It should be noticed that this method necessitates the use of a cantilever axle, that is to say, the wheels must be outside the bogie truck instead of inside, as in figs. 12 and 13.

It may be mentioned that this idea cannot be very well applied to geared motors on tramcars, because the wheel on the axle comes in the way of the cannon bearing at one end. Where traction type motors are used for driving machinery such as rolling mills, hauling gears, &c., the method can, however, be very easily and neatly applied.

THE PARIS EXHIBITION.

Paris, *April 14th.*

It is freely stated here that political considerations have pushed the Government to open the Exhibition at a premature date. The six months' truce which has been tacitly agreed upon by the various political parties for the purpose of ensuring success would seem to have been very grudgingly accepted by the more extreme sections, and only agreed to eventually because of the pressing need of a public pacification. Naturally the journals opposed to the Government declare that it was the "pitiful need of a few more days of security" which has led to the present early inauguration, whilst the opposing organs declare that the inauguration was well timed in view of the practical completion of the buildings.

Be the reason what it may, it is certain that during the last week the work has been pushed forward in a really

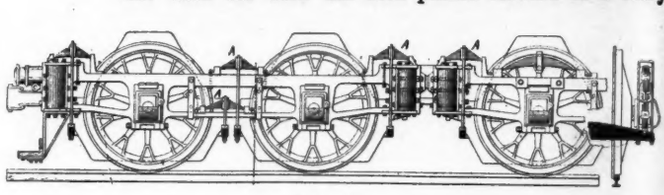

Fig. 14.

marvellous manner. Scaffoldings have been removed, decorations completed, and interiors furnished as if by magic, although the visitor still pays the price of immaturity by the plentiful collection of lime and dust upon his clothes. Nowhere has a greater change been effected in a few hours than in the immense *Salle des Fêtes*. A week ago the flooring was of the nature of a huge dust-heap, to-day it has been converted into a comfortably appointed auditorium. This vast building occupies a portion of the machinery hall of the last exhibition, and some idea of its immensity can be gathered from the fact that 15,000 persons witnessed the inaugural ceremony to-day, and yet failed to fill completely the whole of the seats of the building.

The ceremony was of a brief but imposing character. On the entry of M. Loubet, the President, the orchestra and choir of the Conservatoire, the bands of the Engineers of Versailles and the Republican Guard, under the direction of M. Taffanel, struck up the "Marseillaise," the immense audience rising and singing the national hymn. Whilst the President and his *entourage* were taking their places the "Marche Solennelle" of Massenet was played. Then M. Millerand, the Socialist Minister of Commerce, made the opening speech, a speech distinguished by a great breadth of view and eloquence of expression. He laid special stress on the economic revolution which had been effected by the agents which had been employed to carry on the work of the world. "Steam and electricity," he said, "reduced to the *rôle* of docile servants, have transformed the conditions of existence. The machine has become the queen of the world. Installed as master in our factories, this organism of iron and steel turns out and replaces by a slow and continuous invasion the workers of flesh and bone, who have now become his auxiliaries." Passing on to the international aspect of the Exhibition, he referred to the ever-increasing complexity of international interests brought about by the new means of transport and of intercommunication. Thanks to the railway and the telegraph, "interests, ideas, and sentiments cross and recross upon the whole surface of the globe like light threads along which flies the thought of humanity. This beneficent complexity gives us a glimpse of a new era which was opened to us but yesterday by the International Peace Congress at the Hague." The speech concluded with a fine apostrophe to work as the regenerator, consoler, and liberator of the world, and was followed by a storm of applause.

M. Loubet was greeted by energetic cries of *Vive Loubet!* and *Vive la Republique!* when he rose to take over the Exhibition formally from the Commissaire-General, M. Alfred Picard, and declare it open to the public. France, he said, did not desire merely to show to the world a collection of marvels or to live up to her antique renown for hospitality. Her ambition was much higher and greater. She

tables given before will yield some interesting information, especially as showing the wonderful work the Glasgow

jerk at starting and stopping was taken by four sets of tangential springs attached to the armature sleeve.

wished to add a brilliant contribution to the movement of concord among the peoples of the world and add a glory to the end of a great century. He ran lightly over the various sections represented, and spoke in terms of high praise and thanks of those Governments which had taken part in the work of preparation. He then formally declared the Exhibition open.

Naturally we all expected to hear something from the Premier, M. Waldeck-Rousseau, but whether he deemed his published and placarded speech sufficient, or whether it is true as stated that he "draped himself in his dignity" because his name had been accidentally omitted from the printed programme, it is impossible to say. Suffice it to say he did not speak.

The orchestra and choirs then sang Saint-Saëns hymn to Victor Hugo, and played the heroic march of Theodore Dubois. As the President and party left the Salle, passing through lines of Republican guards and *chasseurs*, the audience and choirs sang the "Marseillaise," accompanied by the whole orchestra. The Presidential party then formed a procession, and passing through the Palace of Electricity and along the whole length of the Champs de Mars embarked at the Pont d'Jena upon the specially-equipped boats which were there waiting.

We were then allowed to visit the Exhibition of the electrical portion, of which I will speak in a subsequent letter.

C. H. G.

(To be continued.)

THE "PARTRIDGE" HIGH TENSION SAFETY DEVICE.

A short time ago we were enabled, by the courtesy of Mr. G. W. Partridge, chief engineer to the London Electric Supply Corporation, Limited, to inspect and to see in operation an apparatus which he has devised for the protection of extra high pressure concentric mains.

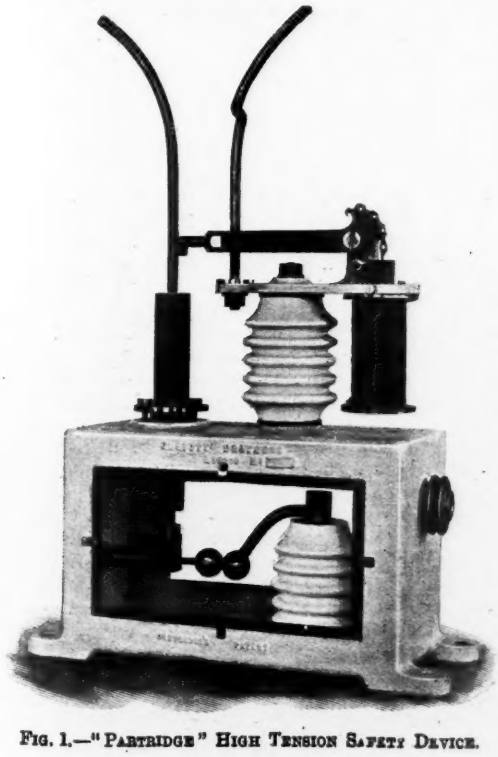

Fig. 1.—"Partridge" High Tension Safety Device.

As is well known, when long mains of this description are suddenly connected to, or disconnected from, a generator working at what is now generally styled "extra high pressure," *i.e.*, over, say, 3,000 volts, violent surgings are set up in the conductors, the potential difference rising far above the normal, and causing excessive stresses to be thrown on the dielectric. These phenomena can be avoided when switching in or out by the use of such apparatus as the "mains discharger," also devised by Mr. Partridge, of which we gave a description in our article on the Willesden generating station; but the circuits are liable to be opened by the blowing of a fuse, or by various other causes, which cannot be prevented from operating. The admirable little instrument which Mr. Partridge has got out to stand sentinel over the cables, absolutely prevents undue rise of pressure by offering a short air-gap over which the electric charge

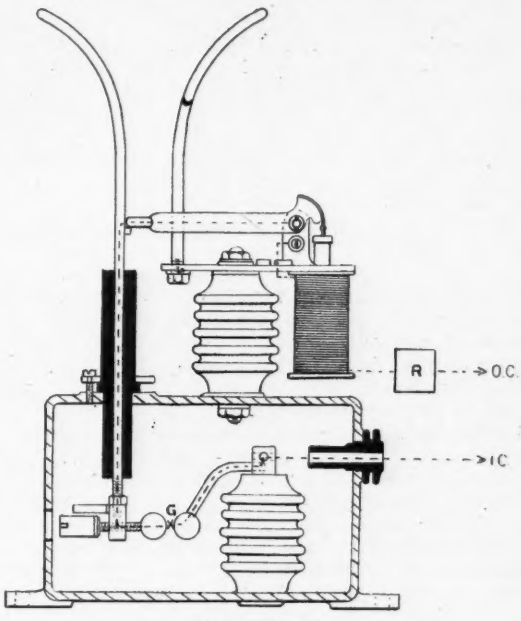

Fig. 2.—Diagram.

can leap, and then suddenly increasing the length of the path in air until the resulting arc is broken. A reference to fig. 1, a photograph of the original, and fig. 2, a diagram showing the path of the current, will make the action clear.

The inner conductor, I C, it will be observed, is connected with an insulated metal ball, and with nothing else at all. Opposite this ball is a similar one, carried on a screw stem, by means of which the gap, G, between the balls can be adjusted from outside. Connected with the second ball is an insulated brass rod which is prolonged into a curved horn outside the closed box; a corresponding horn makes with this the well-known diverging horn "lightning arrester" type of arc-breaker, originally used by Elihu Thomson, and widely employed on the Continent in connection with overhead electric lines. A pivoted arm is arranged so as to normally short circuit the two horns, and is linked to an armature hanging in a solenoid, which is connected between the "arrester" and the earthed outer conductor O C in series with a non-inductive resistance R.

The air-gap, G, is adjusted for any predetermined rise of pressure. When the set limit is exceeded, a spark crosses the gap, and a discharge occurs between the inner and outer conductors through the short-circuited arc-breaker, solenoid, and non-inductive resistance.

The solenoid instantly pulls up the arm until it strikes a "kink" in the adjacent horn, leaving a wide air-gap in the path of the discharge; the upward current of air heated by the resultant arc carries the latter on towards the diverging tips of the horns, and thus increases the length of the arc until it breaks. The arm then falls again, and all is ready for the next occasion. It will be noticed that all exposed parts are normally connected with the outer conductor only,

such as rolling mills, hauling gears, &c., the method can, however, be very easily and neatly applied.

of marvels or to live up to her antique renown for hospitality. Her ambition was much higher and greater. She

and that the high pressure terminal is completely enclosed in a glazed box.

The efficacy of the apparatus was demonstrated to us by a series of experiments made in a transformer sub-station of the London Electric Supply Corporation; electric surgings were artificially set up in the 10,000-volt mains by switching circuits on and off, and the safety device, which was adjusted for less than 25 per cent. over-pressure, repeatedly and unfailingly discharged the mains and broke the arc when the limit was exceeded. Having regard to the number of extra high pressure underground transmission lines which are growing up in this country, we have no doubt that Mr. Partridge's clever device will be found in great demand.

WHY SHOULD LONDON WAIT?

Is there any occult affinity in this great metropolis between electromobiles and grand opera? It has for years been a standing reproach to us that the largest and most opulent city in the world, with its millions of inhabitants, cannot support two opera houses for more than a few weeks each season; indeed, there have been years when one house has been more than enough for the enthusiastic *entrepreneur* who was rash enough to risk his all in the effort to dispel the Continental belief that England is not a musical nation. Germany, in its small towns of under 50,000 people, can support grand opera for the better part of the 12 months; New York City can support a public cab service using electromobile cabs, which has grown up and been kept in continual operation through all sorts of weather for three years, during which time the number of its vehicles in service has quadrupled, and new cabs cannot be obtained from the manufacturers rapidly enough for its growing demands.

London has witnessed two attempts to place a service of electrical cabs in its streets of over-congested traffic. After a few weeks of half-hearted trial the vehicles have been withdrawn. Is this failure due to what Lord Roberts would probably call "errors of judgment and want of administrative capacity" on the part of the *entrepreneurs*, was it caused by immature and impracticable machinery, or did the public fail to patronise the venture?

In the United States it has long been recognised as an axiom that nothing else was suitable as an automobile power so long as electricity could be used for that purpose.

The local conditions of New York streets are certainly not the same as those of London, but differences such as these will not account for our absolute lack of travelling conveniences in the shape of comfortable and swift electrically-propelled cabs.

The New York Electric Vehicle Transportation Company have more than 200 public vehicles upon the streets, embracing no less than 12 styles—three varieties of broughams, two kinds of hansoms, two different types of victorias, &c.

Electric power is held to be, except for its cost, almost an ideal power, as it is safe, reliable, noiseless, non-explosive, and its operation is simple and easily understood. Its drawbacks are greater cost, both original and per mile, and limited range of running from the necessity of frequent re-charging of the secondary cells. While our trans-Atlantic cousins grant that other motive powers may find more successful applications for general touring and for use over long stretches of country, yet nothing else can approach the silence, effectiveness, simplicity, ease of control, and general absence of disagreeable qualities of the electric motor, which renders it the best form of power-generating device for such vehicles as are used for the most part in city streets.

Mr. Hiram Percy Maxim, chief engineer of the Columbia and Electric Vehicle Company, of Hartford, has publicly stated that, notwithstanding the limitations to the radius of operations, and the comparatively long time required to recharge its storage batteries, the present electric cab is an entirely practical and successful machine commercially, and one behind which any manufacturer of intelligence and ability can stand with a reasonable guarantee.

So rapid has been the progress of electrically-propelled vehicles in the States, that our New York namesake devoted one of its recent issues wholly to the electromobile industry. Between two and three dozen types of carriage are illustrated and described, but in no case do we find reliable electrical data concerning the life and soul of the vehicle, the accumulator. Most of the companies seem to develop a type of cell for themselves which appears to satisfy commercial requirements.

Our contemporary would render good service to the industry by giving complete descriptions and data of the various batteries used on the vehicles which it has so fully illustrated, something beyond mere dead weight which makers invariably state could be reduced in future carriages.

There is certainly evidence of much striving after lightness, high rate of charge and discharge, long life and freedom from buckling, but we have no information as to whether these desirable features have wholly, or in part, been obtained.

That there is still room for further improvement in these directions is plain from Mr. Maxim's statement that of the three types of automobiles—steam, gasoline and electric—the latter would develop most rapidly, largely dependent, of course, upon the lessening of weight and the increased capacity of the storage battery.

If these desiderata can be accomplished in the States, where experience in the manufacture and working of secondary cells is certainly less than has been accumulated in this country, why should we still be without a battery which will enable electric cabs to be run commercially successfully in London? In fine, why are we not as well provided with electromobiles as New York and some other American cities?

CORRESPONDENCE.

Tests of a Ventilating Fan.

In view of the comments following my recent letter upon this subject, I should like to supplement my previous remarks on the points now raised, if I may once more encroach upon your space.

The true measure of the work done by the fan is that required at the point of maximum resistance, viz., through the fan itself, where the effective area is least, and therefore where the difference of water gauge on the two sides of the section must be greatest. In this case the cross-sectional area of the testing box was greater than the fan area, and the water gauge readings taken between the fan and the end of the box would be less than the difference of pressure required to propel the air through the fan, and are therefore no measure of the maximum work done upon the air. Obviously, by a sufficient increase in the area of the box and consequent reduction of velocity, the pressure inside the box might be made as nearly atmospheric as desired. If the area at the end of the box were reduced until it equalled the area of the fan, the water gauge reading taken between the fan and the end of the box would be found to be quite $\frac{3}{4}$ inch, and there must have been this difference of pressure to give the velocity through the fan.

Since the motor could not develop more than 7 H.P. it seems probable that the mistake lay in the quantity of air rather than in the power, which is certainly likely, as the difficulty in getting reliable readings of air quantities is notorious. While mentioning the subject of air quantities a protest should be raised against the use of "cubic feet per horse-power" as a means of comparing results, as that cannot be a constant ratio at all speeds of a fan. With fans of the propeller type, as in the present case, the volume of air is proportional to the speed, while the power required varies nearly as the third power of the speed, so that the volume per horse-power must become less as the speed increases, although the total volume delivered will be greater at the higher speed, and this ratio may be made very large by calculating it at as low a speed as possible, but will not be a measure of the output per horse-power at any other speed. As an example, assume that the power varies exactly as the cube of the speed, then 20,000 cubic feet per minute may be delivered by the first horse-power; but to deliver 40,000 cubic feet per minute we should require 8 H.P., which would be 5,000 cubic feet per horse-power. This shows at once the objection to stating the performance of a fan in volume of air per minute per horse-power without giving

suddenly connected to, or disconnected from, a generator

parts are normally connected with the outer conductor only,

further particulars, and such a statement is apt to be very misleading to a person unacquainted with the subject.

Centrifugal.

April 12th, 1900.

[On the subject of the test to which our correspondent "Centrifugal" refers, we have made a very simple calculation, which at first seems to aggravate the difficulty, but leads us to a hypothesis which may prove to be the solution.

The velocity of the air in the fan area is readily found to be 3,160 feet per minute, or 52·7 feet per second. The volume of air moved per minute was 89,468 cubic feet, weighing about 6,900 lbs.; this is equivalent to 115 lbs. moved per second.

We have, then, a mass of 115 lbs. raised to a speed of 52·7 feet per second during each second; this involves an expenditure of $115 \div 64 \times 52{\cdot}7 \times 52{\cdot}7$ foot-lbs. per second, or 9½ H.P. This is quite apart from the loss in the fan, which brings up the gross power to at least 12 H.P.

How is it, then, that in the test under discussion, the results of which we fully accept, 5 H.P. was sufficient? We put forth the suggestion for what it is worth, that the fan, under the conditions described, created a vortex, the same air, or, rather, great part of it, circulating repeatedly through the fan without losing its acquired velocity. This would account for the small power required to drive the fan. If, however, the fan were placed in an aperture in a wall of great extent in all directions, so as to absolutely prohibit the formation of a vortex, at least 12 H.P. would be required to drive the same quantity of air per minute through the partition—or what is more probable, the delivery, &c., would assume quite different values.

"Centrifugal's" remarks *re* the rating of fans in cubic feet per minute per H.P. appear to be well grounded, and we accept the implied correction.

Mr. Steavenson's letter, published in our last issue, really applies only to centrifugal fans, which differ to a considerable extent from fans of the Blackman type.—Eds. Elec. Rev.]

The Electrical Equipment of Ships of War.

In Mr. C. E. Grove's interesting summary of the uses of electricity on ships of war since its first introduction in the Royal Navy in 1875, published in the last issues of the Review, I notice under the head of dynamos a statement that the dynamo installed in H.M.S. *Minotaur* in 1876 was a "magneto machine."

Faraday, in his "First Series of Experimental Researches," *Phil. Trans.*, 1832, p. 138, defined the exact meaning to be given to the term magneto-electricity in the following paragraph:—"58. The similarity of action, almost amounting to identity between common magnets and either electro-magnets or volta-electric currents, is strikingly in accordance with, and confirmatory of, Ampere's theory, and furnishes powerful reasons for believing that the action is the same in both cases; but, as a distinction in language is still necessary, I propose to call the agency thus exerted by ordinary magnets, *magneto-electric* or *magnelectric* induction (26)."

All machines, therefore, that generate electricity from ordinary steel magnets are, according to Faraday's definition, magneto-electric machines. Now, the machines established under my direction on the *Minotaur* and on other battleships in 1875—1880, were self-exciting multipolar dynamos, constructed in accordance with the specification of my patent of March, 1867, in which permanent steel magnets were dispensed with. Further descriptions of these dynamos for lighting and for the electro-deposition of metals were published in the *Philosophical Magazine*, 1873, and in other journals. I have elsewhere directed attention to the fact that the term "dynamo-electric machine," was invented by Charles Brooke, F.R.S., who applied it expressly to my electro-magnetic generator (*Proc. Royal Soc.*, Vol. xv. (1867), p. 409). I may also mention that the general method of searchlight signalling with the vertical beam, by means of a reflecting disc mounted horizontally on a spindle in front of the projector and vibrating the disc by means of a lever handle, was invented and applied by me on the *Minotaur* in 1876.

Henry Wilde.

Alderley Edge, *April 17th*, 1900.

Electric Motors for Driving Grinding Stones.

I am surprised at the letter of Mr. G. R. Peers in your issue of 13th inst.

I grind both oats and maize with electric power, and, of course, there is not the slightest difference in the product as to what power you use. All that is necessary is to see that your motor is of sufficient capacity for the work required, and to regulate the speed of the stones by the size of pulleys on motor and mill gearing. I consider a belt drive from motor to mill gear best, as it is easier on the motor than direct connected spur gear.

I would allow from 6 to 8 H.P. for 4·6 stones on Indian corn, or 10 H.P. for fast work, but much depends on the gearing of the stones, as some are harder to drive than others, and on the output required.

J. E. Ritter.

Limavady, *April 16th*.

Construction of Overhead Equipments.

Surely the author of "The Construction of Overhead Equipments," at present appearing in your paper, is in error regarding his conclusion as to "the effective lateral pull" produced on a pole by a bracket.

On page 599 of last Friday's issue, he states that the effective lateral pull on a 20 feet pole, caused by a 5 feet bracket arm and attachments is 360 lbs., and it would appear from his figures that the effect of *increasing* the length of the bracket arm would be to *diminish* the lateral pull on the pole!

Surely, however, this bending moment, namely, 90 lbs. at a radius of 5 feet, would produce no greater deflection at the top of the pole than would a pull of about 35 lbs. applied laterally. For a 20 feet bracket arm, allowing for the weight of the same as well as for the weight of the trolley wire, and taking the author's figure of 200 lbs. at 20 feet leverage, the equivalent lateral pull, as defined above, would be only about 300 lbs. This, of course, on the assumption that we are working on a straight run and not on a curve.

J. M. D.

London, E.C., *April 11th*.

Wiremen's Woes.

As you have kindly allowed "H. W. H." to ventilate his woes, perhaps you will allow one of the dense labourers to reply. "H. W. H." thinks a dense labourer has no right to lift himself out of the mud. This is trade unionism, the *oppressor* of the labourer. "H. W. H." must have swallowed the catechism of the A.S.E. "H. W. H.," like many more apprentices, thinks when they are out of their time they are full-blown consulting engineers, and then takes the hump because their employers think different.

Not many years ago I started as a wireman's assistant (labourer), within a short time I was getting the then top price on the N.E. coast, 7½d. per hour; another young fellow started at the same time as myself, but he had a better education and was not so dense as myself. It is most likely the friendly competition between us two was the means of our success, and we both occupy a good position to-day, so you see mine is no exceptional case; in fact, there are hundreds of parallel cases.

Since then I have had charge of the wiring for power plants, some of them 1,000 H.P. I have also had charge of repairs to motors, dynamos, and alternators, the building of switchboards, and general installation work, and at present I have charge of the erection of a plant of over 1,000 KW.

Perhaps "H. W. H." will think it has been a walk over, but it has not, it has cost me hours and hours of hard work, when "H. W. H." has either been enjoying himself or asleep. When his day's work has been done, mine has often only just commenced, for I am exceptionally dense, I ran away from home and school before I was 13 years old, and I have never entered a school but once since, and that was to vote. Many times I have been from tea time to the early hours of the morning drawing such paltry things as eyebolts, shackles, and small details that I required making at the works; when these drawings have been done the

one of its recent issues wholly to the electromobile industry.

volume of air per minute per horse-power without giving

smallest boy in the drawing office would be ashamed to put his name to them. My ordinary everyday calculations often keep me up till the cock crows, and the writing of my weekly report is purgatory; besides this I have to study in my tin-pot way, or I could never carry out the work entrusted to me. I have never had anyone to whom I could appeal for help; in fact, had I done so, I should have betrayed my ignorance. When I meet a difficulty I hammer at it night after night until I overcome it. I could give you instances where I have been weeks solving very easy problems that a schoolboy would laugh at; during this time I have had the moral support of a good wife, who has less education than myself, but who has often denied herself little luxuries to buy me books.

Now, what I wish to impress on "H. W. H." is, that although only dense labourers, we have a perfect right to lift ourselves out of the mud, and employers have the right to advance a man, even a labourer, if they see the man is worthy of his hire. My employers don't know—possibly it is as well they don't—that I have been a labourer; but they know that I am exceptionally dense, and have had no education, but still they have confidence in me, and I am proud of it, and I will stick at nothing as far as work is concerned to further their interests; they pay me well—this is what raises the voice of "H. W. H." and all trade unionists; they are afraid another man should get something they think they alone have the right to have. I am sorry I am not that dense labourer "H. W. H." writes about, but I hope he will persevere, and if ever I meet him, I will fall on his neck and worship him.

I could write "H. W. H." the 20 years' life of a dense labourer. During this time I have visited Africa, Australia, America, and all the European countries, from the land of the Midnight Sun to the sunny shores of Southern Italy, and to show how dense I am, I have only succeeded in learning a few words of some languages, and none of others, and yet I have been sent by firms who had fitters (engineers) who could speak both French and German, and I was employed by these firms as a labourer, afterwards called a driver. During all these 20 years I have been oppressed and persecuted by trades unions, especially the A.S.E., and I feel sure, by the tone of "H. W. H's." letter, he is a trades unionist.

Dense, very Dense, Labourer.

THE JOHNSON-LUNDELL ELECTRIC TRACTION COMPANY, LIMITED.

Mr. E. H. Johnson is no stranger to this country—on the contrary, many of our readers have the pleasure of his acquaintance; it is many years since he first visited our

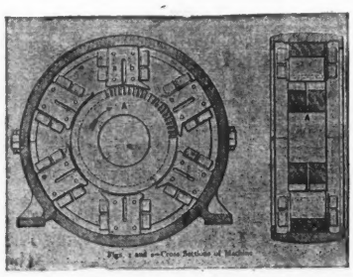

Fig. 1. Fig. 2.

shores, as representative of Mr. Edison, at a time when a "Jumbo" dynamo was looked upon as up-to-date, or a little ahead, and before Dr. Hopkinson had revolutionised the design of the magnetic circuit. Four years ago he returned to introduce the now famous "Lundell" motor; the British patents were purchased by Messrs. J. H. Holmes & Co., who have been instrumental in establishing the machine to the same extent in this country as it is in the United States and Germany. Mr. Johnson has now come over with a sheaf of patents and inventions, and profiting by his previous experience, has allied himself with the same firm for the purpose of forming a company under the title with which we head this article. We understand that the present promotion is to constitute a parent company, to purchase all the Johnson-Lundell traction interests in Europe. The foreign patents will be sold, but the company will retain and work the English rights.

The chief assets of the new company, which was registered on Tuesday last, will consist of the inventions patented by Mr. Robert Lundell, who is associated with Mr. Johnson, for improvements in dynamos, motors, controllers, methods

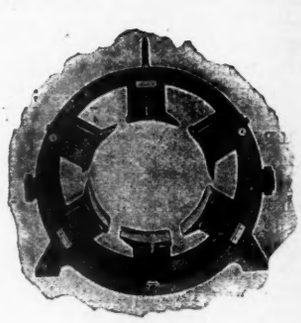

Fig. 3.

of motor control, electric braking, and electric traction on the surface contact system. By the courtesy of Mr. Johnson and Mr. Leonard Holmes, chairman of the company, we are enabled to give the following brief description of the apparatus and methods in question:—

The new dynamo is based upon the recent discovery by Mr. Lundell of a means for obviating that *bête noire* of electrical engineers—sparking at the brushes. This is effected by the exceedingly simple device shown in figs. 1 and 2, from which it will be seen that the field magnet core is divided by a longitudinal slit into two portions, **a** and **b**, in fig. 1, and that the leading pole tip, **a**, is abbreviated, while the trailing

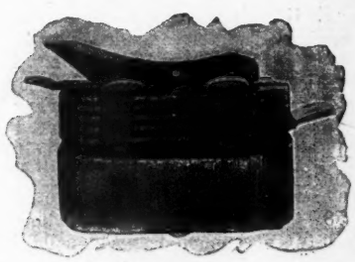

Fig. 4.

tip, **b**, is prolonged into a taper extension. The effect of this construction is to reduce the magnetic reluctance of the circuit through **b**, causing a so much greater flux through that leg than through the other that the former is practically saturated at all loads.

The magnetic distortion is by this means greatly reduced, while the effect of the compounding ampere-turns is to increase the flux through **a** only, and to ensure a suitable field for commutation at all loads. A view of the skeleton of the field magnet is given in fig. 3, while fig. 4 shows a complete magnet limb and pole-piece with shunt and series coils in place. So effective is this construction, that we are assured on the highest authority that the machine is *absolutely* sparkless from no load to at least 25 per cent. overload, without shifting the brushes, while at the same time the cost of construction of the machine is said to be reduced by not less than 15 per cent.

The armature is of the usual toothed core drum type, as shown in fig. 5, while the complete machine is represented in fig. 6. The brushholders are carried by springy plates, which give a parallel feed to the brushes—a device at one time employed by Messrs. J. H. Holmes & Co. A notable improvement has been effected in the design of the carbon brushes, which are not carried in a box,

Alderley Edge, *April 17th*, 1900.

at the works; when these drawings have been done the

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but are held by a screw passing through a slot in the brush. This device, which is shown in fig. 7, enables the brushes to be set closer together, shortening the necessary length of the commutator, while the brushes may be reversed when partly worn, with consequent saving in renewals. Figs. 8 and 9 show the efficiency curves and other data relating to a 100-KW. machine, the first of that size to be built, which require no explanation; this machine was coupled to a Browett-Lindley engine, and the combination, although brand new, gave an over-all efficiency of 84 per cent.

FIG. 5.

The traction motor, the detailed description of which must be deferred, is provided with two commutators, while its design is such as to admit of an extreme range of magnetisation, with a corresponding range of speed variation. This is used in conjunction with a novel controller devised

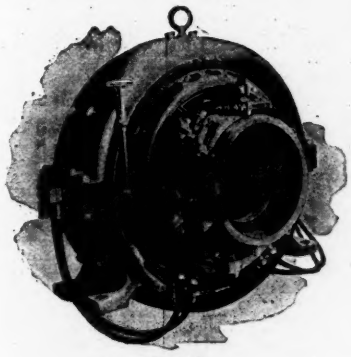


FIG. 6.

by Mr. Lundell, in which the speed is regulated by variation of the field strength. Two motors are employed on each car, and are, as regards control, equivalent to four, though they are no larger than the ordinary machines; the series-parallel method of control is therefore here carried a stage further,

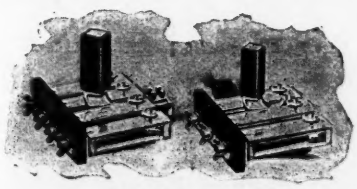


FIG. 7.

enabling the inventor to entirely dispense with regulating resistances and magnetic blow-out devices. It is stated that by this means the acceleration to full speed of a tramcar can be accomplished in perfectly uniform steps, while he jerk usually experienced at the moment of switching from series to parallel is avoided; at the moment when the latter step is performed, the fields of the motors, by virtue of their wide range of variation, can be instantly strengthened, so as to bring the counter E.M.F. of the motors to the necessary value to withstand the increased pressure applied to the terminals. This principle is carried still further in the use of the motors themselves for braking purposes—a feature upon which the company prides itself. By increasing the fields in this way, and reversing the controller, the motors can be made to overcome the line pressure and act as dynamos, sending current into the line; this braking action can be continued from the maximum speed down to one-third of that value, before mechanical braking becomes necessary.

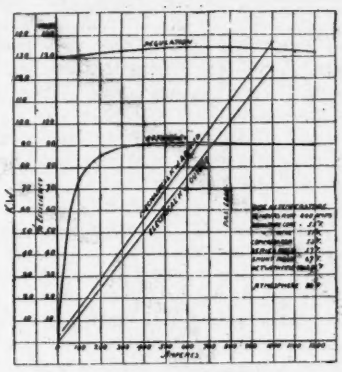


FIG. 8.—100 KW. LUNDELL L.T. GENERATOR, 254 R.P.M., 125 VOLTS.

Such a feat would be impossible with a pure series motor; but those under consideration are provided with a compound winding. While used for braking, the current does not exceed the normal value, so that the motors are not liable to over-heating; while, as the kinetic energy of the car is restored to the supply mains, the economy derived from the system is considerable. When applied to automobiles, the same action is employed for re-charging the battery on down grades.

Passing now to the Johnson-Lundell surface contact system, we may remind our readers that these inventors worked out a system employing a double row of contact

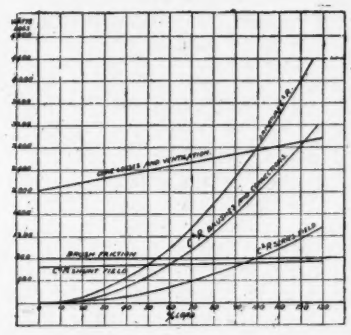


FIG. 9.—LOSSES IN WATTS OF A 100 KW. LUNDELL L.T. GENERATOR 254 R.P.M., 125 VOLTS.

studs in 1896; the present arrangement has been evolved from the earlier one, at a cost of much labour, and something like £40,000 in cash. Previous devices have been directed towards operating a switch under the roadway by means of a magnet carried on the car, so as to close the main circuit itself; in the new system, a relay only is actuated in this way, so that much smaller forces are required, while the power available to close or open the main switches, under the control of the relay, is practically unlimited. Moreover, as the skate itself forms one magnetic pole, while the magnetic circuit is completed *viâ* the car wheels, rails, and tie rods, the departure of the car involves the removal of half the magnetic circuit, and effectually prevents sticking of the relay due to residual magnetism. The relay being operated magnetically, electrical leakage of whatever magnitude cannot possibly cause sticking. A special arrangement is provided for crossings, where short circuits are liable to occur; a fuse in the main circuit is shunted with a resistance, so that in the event of a short occurring the fuse blows and leaves the resistance in circuit, limiting the maximum current to 25

amperes, but not cutting it off entirely, so that the car is not made helpless. By installing a storage battery of small dimensions on the car, to provide for starting, &c., it is claimed that the electrical contact equipment may be dispensed with on descending grades and on levels; the battery is charged on ascending grades and other parts of the line where contacts are indispensable, and need never be removed from the car for recharging. We fear, however, that until vast improvements in the construction of storage batteries have been effected, this part of the scheme will be found impracticable. The relay is connected with an auxiliary low pressure (50-volt) circuit, so as to reduce the sparking at the relay contacts.

An experimental line, 3,700 feet in length, was laid down in New York on this system of surface contacts, and is said to have operated for some months in all weathers—even when flooded with water—with entire success.

For the present the dynamos are to be manufactured by Messrs. J. H. Holmes & Co., while motors and controllers will be supplied by the Sprague Electric Company, of New York, which is already manufacturing Lundell generators on a large scale; but as soon as the business is well established, works will be erected and equipped for the manufacture of the company's apparatus in this country.

Turning now to the commercial aspect of the new concern, we have pleasure in noting the thoroughly sound and non-speculative character of the undertaking. The authorised capital is £300,000, divided into 60,000 shares of £5 each, of which 20,000 are taken by the vendors in part payment, the remainder of the purchase price, which is fixed at £200,000, being payable in cash. The property of the company will consist of the European and Colonial (except Canadian) patents for the inventions above enumerated, together with numerous minor patents and certain shares in other companies.

We have been permitted to examine the prospectus, which is shortly to be issued, and which embodies favourable reports from many distinguished British engineers, as well as from a well-known expert in patent law on the validity of the fundamental patents. The question of the equity of the purchase price has been reported upon by high authorities, who regard the valuation as fair and reasonable. At first sight the price appears to us to be excessive; but after careful consideration of the substance of the patents, and having regard to the importance of those relating to dynamo construction and motor control, as well as to the wide area to be exploited, we are inclined to moderate this view—especially as we are informed that negotiations which have already been instituted indicate that the sale of the Continental patents is likely to realise a sum not less than the original purchase price. A remarkable feature of the flotation is the fact that while the whole of the purchase price is underwritten, no less than one-third of it has been actually subscribed for by the underwriters themselves. We have seen the list of underwriters, who are drawn literally from all parts of the country, and note that a large proportion of them are engaged in commercial enterprises, while the speculative element is conspicuous by its absence. The business of the company will not be confined to electric traction, but will embrace the manufacture of dynamos and motors for all purposes; it is intended to secure the best men available for the working staff, and to commence work with the least possible delay. Mr. Leonard W. Holmes will be chairman of the company, supported by an able directorate of gentlemen well known in the world of industry, including Mr. E. H. Johnson; we may add that the association of the new concern with the name of Messrs. J. H. Holmes & Co., a firm whose reputation for commercial integrity is second to that of none, in itself is a guarantee of the *bona fides* of the undertaking.

Private Bills.—The Metropolitan District Railway Company and the Whitechapel and Bow Railway Company have deposited requisitions to withdraw their petitions against the Charing Cross and Strand Electricity Supply Bill. When the House meets on Thursday, April 26th, the second reading of the City of London Electric Lighting Bill and the Metropolitan District Railway Bill will be taken.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending April 11th, 1899.		Week ending April 10th, 1900.	
Amsterdam	Value £20	Adelaide	Value £81
Boca	15	„ Teleg. mat.	352
Bombay	140	Amsterdam	855
Buenos Ayres	1,337	Brussels	10
„ Teleg. mat.	160	Calcutta	1,449
Calcutta	321	Cape Town	50
Cape Town	508	„ Teleg. mat.	2,412
Copenhagen	49	Channel Islands	19
Durban	847	Chinde. Teleg. wire	124
East London	3,461	Christiania. Teleg. wire	62
Hamburg	110	East London	113
Hong Kong	182	Gibraltar	60
Lisbon. Teleg. mat.	80	Gothenburg. Teleg. wire	158
Madras	196	Hamburg Teleg. mat.	400
„ Teleg. mat.	134	Lisbon	28
Malta. Teleg. instruments	1,450	Madras	535
Melbourne. Teleg. mat.	773	Malta	18
Nelson. Teleg. mat.	115	Mauritius	20
Ostend	35	Melbourne. Teleg. wire	1,605
Port Elizabeth.	110	Ostend	167
Shanghai	295	Rotterdam. Teleg. mat.	200
Singapore	20	Rouen	60
„ Teleg. mat.	63	Shanghai	166
Stockholm. Teleg. mat.	155	„ 67 tons old teleg. wire	—
Sydney	885	Singapore	122
„ Teleph. mat.	106	„ Teleg. mat.	179
Trinidad	18	Sydney	1,924
Wellington	182	„ Teleg. mat.	170
Yokohama	190	Wellington	367
Total	£12,852	Total	£10,407

Foreign Goods Transhipped.

Perth. Elec. goods .. Value £201

Electrical Wares Exported.

Week ending April 18th, 1899.		Week ending April 17th, 1900.	
Aden. Teleg. mat.	Value £50	Adelaide	Value £562
„ Telephones	100	Alexandria	10
Alexandria	74	Amsterdam	175
Amsterdam	54	Auckland	70
Antwerp	27	Bangkok	706
Ballek Pappen (Java). Teleg. cable	290	Bombay	12
Bangkok	11	Boulogne	85
Bombay	38	Brisbane	115
„ Teleg. mat.	133	Cape Town	37
Boulogne	18	Colombo	13
Buenos Ayres	906	Copenhagen. Teleg. mat.	140
„ Teleg. mat.	441	Durban	534
Calcutta	522	Fremantle	102
Cape Town	1,267	Ghent	18
Durban	486	Gibraltar	17
East London	83	Hong Kong	617
Genoa	70	„ Teleg. mat.	63
Hong Kong	45	„ Teleg. stores	20
Launceston	15	Kobe. Teleph. cable	1,173
Madeira	29	Melbourne.	94
Madras	11	Nagasaki Teleg. cable	20,000
Malta	51	Penang. Submarine cable	196
Newcastle (N.S.W.)	480	Perth	189
Ostend	81	Rangoon	604
Port Elizabeth	1,064	Rotterdam. Teleg. mat.	61
Rio Grande do Sul	30	St. Petersburg. Ships' Telegs.	450
Santos	140	St. Thomas. Teleg. cable	35,000
Shanghai	50	Singapore	85
Singapore	19	„ Teleph. mat.	505
„ Teleg. mat.	69	Sydney	181
Spezzia	245	Wellington	40
Stockholm	425	Yokohama	2,450
Sydney	1,673		
„ Teleg. mat.	635		
Tientsin	11		
Wellington	65		
„ Teleg. mat.	1,715		
Yokohama	178		
Zanzibar. Teleg. mat.	26		
Total	£11,677	Total	£67,974

Foreign Goods Transhipped.

East London. Elec. lgt. fittings £416 | Brisbane. Teleg. appts. .. £211

Application for Amendment of Patent.—Notice appears in our advertisement pages of an application made by J. P. Hall and W. H. S. Craven for leave to amend Patent No. 24,084, of 1896, for improvements in switches for electro-motors.

Automatic Telephone Company.—In the Court of Appeal judgment was given last week on the appeal by the plaintiffs from an order of Mr Justice Cozens-Hardy, who had declined to make an order in the plaintiffs' favour in an action which had been brought against three of the directors of the company (Mr. Max Margowski, Dr. Schwann, and Mr. J. W. Cahen) for a declaration that they were bound to pay prior to, or at the date of, the action the application and allotment money due on shares which were held by them. The Master of the Rolls came to the conclusion that the defendants were not justified in acting as they did. The agreement was one which could not be held to be binding upon the company. The charges of fraud, however, which had been made against the defendants had not been sustained, and the proper order therefore would be to allow the appeal and reverse the judgment appealed from.

Belgium.—A company has just been formed in Brussels with a capital of £100,000 to be known as La Société Belge d'Electricité A. E. G, to carry on the Belgian branch of the Allgemeine Electricitäts Gesellschaft, of Berlin.

Bankruptcy Proceedings.—Application for discharge will be made at the London Bankruptcy Court on April 27th on behalf of W. P. O'Reilly, manufacturing electrician.

Liquidations, Dissolutions, &c.—Messrs. F. R. Hill and A. V. Gifkins (Hill, Gifkins & Co.), have dissolved partnership by mutual consent. The business will in future be carried on by Mr. Gifkins, under the style of A. V. Gifkins & Co. Mr. Gifkins takes over all assets and liabilities of the late firm, and will pay and receive all accounts due.

Creditors of the Commercial Ozone Syndicate must send particulars of debts or claims to the liquidator, W. W. Futcher, 13 and 14, Basinghall Street, E.C., by May 1st.

The Merveilleuse Electric Arc Lamp Syndicate will meet on May 14th, at 318, Dashwood House, E.C., to hear an account of the winding-up from the liquidator, Mr. Alfred Conder.

Messrs. Bryan Donkin & Co., Limited, are winding-up voluntarily, Messrs. R. Rodgers and H. A. Sanders being appointed liquidators, with powers to carry into effect certain agreements made between Bryan Donkin & Co., the Donkin Land Company, Clench & Co., Limited, and S. L. Mumford, as trustee for Bryan Donkin & Clench, Limited (to be formed.)

A meeting of the Bournemouth and District Electric Supply Company will be held at Moorgate Court, E.C., on May 17th to hear an account of the winding-up from the liquidators.

May 4th is the last day for receiving proofs for intended dividend in the case of the Chitty Dynamo and Motor Company, Limited (in liquidation). Liquidator, G. S. Barnes, 33, Carey Street, W.C.

Book Received.—"Up-to-Date Domestic and Industrial Applications of Electricity," by Alpha. London: S. Rentell & Co., Limited. 1s.

Catalogues and Lists.—Messrs. Davies, Kent & Stewart, of Berners Street, send us a copy of an illustrated sheet showing various additions to their catalogue. These include high voltage ceiling roses, cut-outs, wall sockets, &c.

Messrs. Kynoch's, of Birmingham, have circulated an illustrated booklet relating to their patent roller bearings for shafting, which have now been on the market over two years. We understand that the bearings have been tried by some of the leading engineering firms in the country, and a saving in power has been effected.

The B.T.H. Company's pamphlet, No. 61, describes the G.E. 60 traction motor.

The Improved Glow Lamp Company sends us a copy of its latest illustrated catalogues, particularising its specialities and drawing attention to the special suitability of its conical shape reflector lamps for the purpose of street lighting. It is stated that the alterations which have to be made in the ordinary gas lamps to render them suitable for the use of electricity have been an obstacle by reason of the poor result obtained by the ordinary pear-shaped incandescent lamps, and of the difficulty in obtaining a fitting to give the desired amount of reflection. The same remarks apply to some extent to the use of arc lamps in conjunction with side brackets and pear-shape lamps, and it must be obvious that the result when an incandescent lamp is substituted for an arc lamp cannot be good. Under these circumstances it is claimed that the improved glow lamps mentioned, by reason of their shape and reflection, tend to remove some of the difficulties by which street lighting is attended. Among other users of these lamps for street lighting purposes are the Corporations of Shoreditch, Chester, Bootle, Portsmouth, &c.

The Copper Market.—The last issue of Messrs. H. R. Merton & Company's fortnightly circular shows that while deliveries have amounted to 8,160 tons during the first half of April, and 450 tons of "Standard" have been shipped to New York, supplies during the same period have totalled 10,620 tons, and stocks have therefore increased by 2,000 tons. Adding the 1,700 tons gained in March, and the 1,600 tons gained in February, it is found that since January 31st of this year, stocks of copper have benefited to the extent of 5,300 tons. Notwithstanding this increase, the prices have advanced from £71 5s. to £78 17s. 6d. in the same period. The total of 10,620 tons is made up of 7,013 tons from America, 1,240 tons from Spain and Portugal, 1,100 tons from Chili, 800 tons from Australia, and 467 tons from "other" countries. All of these totals, with the exception of the last two, are above the average. It is interesting to note that the total supplies for March were the highest ever reached for a single month, and that towards the total of 25,421 tons, North America contributed 15,147 tons. This latter is over 4,000 tons above the average for the preceding 12 months, and the deliveries for the first half of April from North America have reached 7,013 tons. The actual figures for the stock, supplies, deliveries, and prices of copper for the first three and a half months of the current year are of considerable interest, and they are given below:—

	Stocks.	Supplies.	Deliveries.	Price.
December 31st, 1899 ..	22,817	..	..	£70 0 0
January 31st, 1900 ..	21,327	19,267	20,757	71 5 0
February 28th, 1900 ..	22,982	23,272	21,617	74 15 0
March 31st, 1900 ..	24,632	25,421	23,771	78 12 6
April 15th, 1900	26,642	10,620	8,610	78 17 6

Crystal Electric Lamp Company, Limited v. Hirst.—At the Croydon County Court some days ago this action was heard, it having been remitted from the High Court. Plaintiffs sought to recover £42 3s. 1d., the price of certain electric lamps supplied to the defendant, Mr. Arthur William Hirst, trading as Hirst & Co., electricians, St. Michael's Road, Croydon. The defence raised by Mr. Hood, who appeared for Mr. Hirst, was that the lamps were supplied subject to power to return them if they were not suitable for the purpose for which they were required, and that they were not suitable. After hearing a great deal of evidence, his Honour having reviewed the case, said he had no difficulty in the matter, and had no doubt whatever that the defendant was liable. He would take off £2 and give judgment for the plaintiffs for £40.

Fire.—Early last Saturday morning a fire occurred at the works of W. T. Henley's Telegraph Works Company, Limited, at North Woolwich, but we understand that it was entirely confined to a part of one of their mechanical india-rubber shops, and was of small extent. It will cause no interruption to the business.

The Leyton Vibration Case.—Respecting the injunction made against the Leyton Urban Council last month by Mr. Justice Buckley, at the instance of Mr. Elijah Hawkes, of Cathall Road, on account of an alleged nuisance caused by the noise of the machinery at the Council's Electric Light Works, the matter was, in accordance with instructions, mentioned on Monday last week in Mr. Justice Buckley's Court in the Chancery Division of the High Court of Justice.—His Lordship was informed of the step the Council had taken to prevent the machinery causing a nuisance, and on an undertaking being given that the gas engines at the works should not be run after 11 p.m. he suspended the operation of the injunction pending the hearing of the appeal against his decision.

Monier Fireproof Constructions.—We have received from Mr. E. Lee Heidenreich, of Chicago, who is the sole representative in the United States for the Monier Fireproof Constructions, a pamphlet devoted to a description of these, together with sectional drawings and photographic views of work carried out on this system. The application of this system of building to the construction of tanks and elevators, and in hydraulic engineering, are dwelt upon by the writer. The Monier Construction, it may be as well to mention, consists of two materials, wrought-iron or steel, and mortar, consisting of cement and sand, or cement, sand, and broken stone. The iron or steel is either in the form of rods or wires, known as carrying and distributing rods. The carrying rods being made heavy will take most of the tensile strain of the construction, the distributors being lighter and serving merely to distribute the load evenly over the carrying rods. The two systems of rods are applied like a netting with meshes, varying according to the requirements of the construction. A point claimed in favour of the system is the facility of transportation of the different parts over the wide expanse of irrigating and mining fields, and so on.

Prism Globes.—The Prism Globe Company, Limited, are supplying their globes and fittings for the incandescent street lighting at Poplar and Darwen.

Rimington's Maximum Demand Indicator.—A description of this indicator which is devised specially to work with the Bastian meter, is unfortunately held over until next week because of pressure on our space.

Slump in Iron.—The *Pall Mall Gazette* says that a severe slump was experienced in the Glasgow pig iron market on Wednesday, on the receipt of cables from New York intimating a reduction of 5s. per ton on steel billets. This is the first real setback since the industrial boom started, and bears took advantage to depress values. Scotch iron fell 1s. 7d. per ton and hematite 1s. 2d. Manufacturers report a growing scarcity of fresh orders.

Smoke Nuisance.—At Lambeth last week, Mr. S. H. Webster, Secretary to the South London Electric Supply Corporation, Limited, of Bengeworth Road, Loughborough Junction, appeared to answer two summonses taken out by the Lambeth Vestry, complaining that on March 9th and 19th, the shaft of the company's works sent forth dense black smoke in such quantities as to be a nuisance.—Evidence having been called in support of the summonses, Mr. Wontner, on behalf of the company, said there was the greatest difficulty in avoiding smoke at certain times. When coal was put on it was next to impossible to avoid some amount of smoke. He was informed that every one of the electric lighting companies in London had been summoned and convicted under similar circumstances.—Mr. F. A. Nixon, chief engineer to the corporation, said every conceivable precaution was taken to avoid any nuisance. He believed they used the most improved stoker for preventing smoke.—Mr. Hopkins ordered the company to pay a penalty of £10 and £2 2s. costs.

Southport and Cheshire Lines Extension.—Mr. R. H. Scotter, M.I.M.E., &c., writing to the *Southport Guardian* on "Electric Traction," discusses the relative positions of England and Germany in regard to the matter, and makes a comparison much to the advantage of the latter country. Germany has at present 90 systems of electric tramways and railways covering nearly 2,000 miles of track with 8,000 cars, against, in Great Britain and Ireland, 41 systems with less than 600 miles of track, 69 owned and worked by municipalities, and 230 miles by companies. These figures include underground and overhead lines, but 200 miles have to be added for other lines constructing. The author proceeds as follows:—We may hope that, though electric traction in England has been retarded hitherto by former legislative measures, we are fast catching up our German neighbours, and if we will but profit by their example in some matters, we shall no doubt ultimately romp in on their shoulders. But while they have profited by past experience and are fast superseding the overhead wire or trolley system of electric traction by conduit or surface contact systems, municipal bodies in England are perpetuating and multiplying the overhead wire system. This system can seldom recommend itself, except on the score of cost; and as we are a parsimonious race in the main, up-to-date engineers are often obliged, against their better judgment, to adopt it on account of the aforesaid difficulty of finding their capital. But there are several most excellent conduit or surface-contact systems at work in Germany, and the only thing that I can say against them after years of watching their development, and careful inspection and trial on the spot, is the

initial cost. But we have now to apply experience gained by contemplation of our foreign neighbours to our own immediate needs. One small railway system running out of Munich exactly corresponds to our Cheshire Lines Extension. It was a non-paying concern, but by the conversion of the line into an electric railway it has been revivified; its working expenses have been considerably reduced, and receipts have gone up. . . . . I have formulated a scheme for converting the Southport and Cheshire Lines Extension into an electric railway for passenger service only, leaving the line to be worked by steam as it now is, for long-distance and goods traffic. This scheme will not be costly, and when one remembers that the Liverpool electric trams run close to the Aintree station on the Cheshire Lines Railway, a mode of intercommunication at once suggests itself, the details of which I have carefully considered. These trams will bring thousands of passengers every week as far as Aintree, and it seems reasonable to suppose that were a frequent and regular service of electric trains between Aintree and Southport established a large number of these passengers would avail themselves of the convenience. As "trade follows the flag," so does development of a district invariably follow the granting of increased facilities for cheap and ready transit. Between Aintree and the centre of Liverpool there is a vast business population, who would gladly use such a service to enable them to live at Southport or along the route served by the Cheshire Lines Extension system. Sefton, Lydiate, Ainsdale, and Woodville would undoubtedly become favourite residential localities. The power for working several miles of this electric line would doubtless be supplied by the Southport Corporation at a reasonable rate. But this is only a part of the scheme, and indeed, not the most important part. Southport must for business purposes be brought into touch electrically with Liverpool, Manchester, and other centres of industry by the most direct method, and without change of carriage. To accomplish this, I propose, by arrangement with the Cheshire Lines Committee, to also convert a piece of line running from the terminus of the extension system through Aintree and turning off in a south-easterly direction to Huskisson station, Liverpool, into an electric line; and further, to immediately seek power to construct two tunnels suitable for electric passenger service only from Huskisson, under Liverpool to central station low level. The route suggested gives one station very near the business centre of the city. The use of electricity as the motive power will immensely cheapen both the cost of construction and the working expenses of the line, so that such a system will easily earn a reasonable dividend. At the terminus of the electric railway, central low level station, facilities will be afforded for interchange of passenger traffic with the Mersey railway (which, I hope, will by that time be worked by electricity), and by its route with the Wirral, the Great Western, London and North-Western, and North and South Wales lines. Passengers from Southport will then be able to pass from one railway to another without change of station, and in some cases, as traffic develops, without change of carriage.

Trade Announcements.—Messrs. Charles Joyner & Co., Limited, of Birmingham, have appointed Messrs. Fry & Co., Limited, of 19, Farringdon Avenue, E.C., their sole representatives for London and South Coast. All their latest patterns of gas and electric light fittings can now be seen at their new showroom at above address.

Messrs. P. Ormiston & Sons have removed from Old Street, St. Luke's, to their new mills at 53, Clerkenwell Road, E.C. (close to Hatton Garden). This is in consequence of the old factory being required for the widening of Old Street.

A Works Dispute.—In the Edinburgh Sheriff Small Debt Court, on 11th inst., claims were raised by eleven workmen lately employed with the firm of D. Bruce Peebles & Co., engineers, Tay Works, Bonnington, against that firm for sums from £1 downwards, the amount of wages which they had earned in defenders' employment. Against these claims the defenders made a claim of £5 against each of the men as damages for breach of contract. Proof was led and the witnesses for the pursuers stated that on March 12th they were distinctly told that they need not come into their work next day unless they gave up the society they were connected with—the Electrical Trades Society. The employers denied this, and stated that the men left of their own accord. The society had been agitating the men to strike, and they were not going to be dictated to by the society. Accordingly they told the men that all would be treated alike—union and non-union men. By the men's action a number of important contracts had been delayed, and in one special case they forfeited a bonus of £100, and incurred a penalty. At the conclusion of a prolonged proof, Interim Sheriff Dove Wilson gave decree for the wages earned by the men, and dismissed the counterclaims of the defenders.

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—The Council has asked the Gas and Electric Lighting Committee to procure a return as to the price charged by corporations who have put in electrical installations for lighting and motive power, also the system by which the charges are made and the cost of production per unit.

Barnes and Mortlake.—A Local Government Board inquiry was held on 12th inst. in respect of the loan for electric lighting works in Barnes and Mortlake.

Barnstaple.—The Corporation's provisional order has been reported for second reading.

Barrow.—Mr. C. M. Davis, of Scarborough, has been appointed mains superintendent here.

Bradford.—The City Council has adopted minutes of the Electricity Committee, which included a resolution to appoint Messrs. Mawson & Hudson architects to prepare plans and specifications for the erection of a new building for the extension of the electricity works at Valley Road, including the erection of a new chimney.

Brighouse.—Messrs. Lacey, Clirehugh & Sillar have been authorised to prepare a report dealing with the question of the electric lighting of the town.

Bristol.—At last week's City Council's meeting Alderman Pearson moved the appointment of Mr. K. O. Hale as draughtsman in the city electrical engineer's department, at a salary of £200, rising annually by £30 to £260 per annum. There was an amendment that Mr. Hale's salary should be £160, rising by annual increments of £8 to £200. The amendment was lost.

Alderman Inskip desired to know if the appointment of Mr. Hale would at all interfere with the employment of an architect on the new extension buildings? Alderman Pearson said up to the present the necessity to employ an architect had not arisen. Alderman Inskip pressed for an undertaking from Alderman Pearson that if the necessity arose he would loyally carry out the instructions of the Council. Alderman Pearson said the instruction would be carried out if the Council did not change its mind. Alderman Inskip then moved that the consideration of the report be deferred for three months. The amendment was lost by 32 votes to 16, and the resolution was adopted.

Alderman Pearson moved the adoption of the remaining part of the Electrical Committee's report, recommending that the electrical engineer's plans for the first part of the new station at Avonbank, St. Philip's, be submitted to Sir William Preece, the engineer originally consulted when Bristol was starting its electrical undertaking. The alderman explained that this was not in the slightest degree intended as indicating any want of confidence in Mr. Faraday Proctor, but it was a step considered advisable, because they were, in starting their new works, making new departures, and as they began so they would have to go on. It therefore became important to make sure they were proceeding on the most approved and up-to-date lines. The first section of the works would involve an outlay of £145,000, and future extensions—if the demand for electricity went on increasing—would absorb further capital. The resolution was agreed to.

Cardiff.—At a special meeting of the Lighting and Electrical Committee last week, the engineer (Mr. Appelbee) reported that Messrs. Ferranti had commenced on the 5th inst. to make the alterations agreed upon in court in connection with the engine which they had supplied to the Corporation, and which had not hitherto worked satisfactorily. When the machinery was opened out, the chairman (Alderman Carey) and the vice-chairman (Mr. J. H. Hallett) visited the works, and the latter reported that the wearing parts had deteriorated in an astonishing manner. This he attributed to the material used being unsuitable, and he suggested that an arrangement should be entered into with Messrs. Ferranti to do the work necessary to put the engine in [thorough working order, in addition to what they were required to do under the agreement in court. A letter from Messrs. Ferranti offering to increase the output from 300 to 400 KW. by an alteration in the valve gear and other improvements, at a corresponding increase in the price, was read, but after a long and somewhat acrimonious discussion, it was resolved, on the proposition of Mr. Lewis Morgan, that Mr. Burstall, the expert engaged by the Corporation in their law proceedings against Messrs. Ferranti, be asked to inspect the engine and advise the committee thereon. On the proposition of Mr. Fox, it was resolved that the engine be not worked during one month from April 5th, nor afterwards until certified by Mr. Burstall as being in an efficient and satisfactory condition.

Mr. J. H. Hallett presided at the meeting of the Lighting and Electrical Committee on Tuesday, when the engineer (Mr. Applebee) reported that the total number of 8-C.P. lamps connected at the end of March was 27,463, compared with 21,782 at the corresponding period of last year. There were 1,512 lamps waiting connection. The number of units sold during the year ended March 31st last was 509,000, compared with 405,000 units in the preceding 12 months, a satisfactory increase of 25 per cent. The increase in revenue was £1,500.

Dunblane.—The Local Government Board has granted an electric lighting provisional order to the Urban Supply Company.

East Molesey.—The lighting question is receiving consideration by the Council at present, and particulars are being obtained as to the relative cost of oil, gas, and electricity. There is a proposal to apply for a provisional order for electric lighting, such order to be leased to a company.

Epsom.—The District Council has made a public issue of £16,100 for electric lighting purposes, in 322 debentures of £50 each at 3½ per cent.

Farnworth.—A Local Government Board inquiry was held last week re the Council's application for a £22,000 loan for electric lighting and traction purposes. The proposal is to build a generating station on some freehold land which belongs to the Council, where there will be three steam dynamos, each with a capacity of 120 KW. Two of these are to be for the supply of electricity

for lighting and traction purposes, the third being intended as a reserve. There will be two Lancashire boilers, each 28 feet by 7 feet 6 inches, with economiser, pipes, &c. The plans submitted also show a re-cooler tower, chimney, &c. The present population is estimated at 26,000. The District Council own the tramlines in the township, and have contracted with the Bolton Corporation for the supply of electric power until 1902. Mr. Clirehugh (Messrs. Lacey, Clirehugh & Sillar) consulting electrical engineer to the Council, gave evidence. He said that tenders had been received for the whole of the work, and these went to show that the £22,000 would not be exceeded. He added that it was intended to let the work in sections, and they had obtained as many as 75 tenders for one section. The estimates totalled £21,842, and they had only added 2½ per cent. for contingencies. There was no opposition to the application.

The Electric Lighting Committee have accepted some of the tenders to the specification of Messrs. Lacey, Clirehugh & Sillar, in connection with the electric lighting station, which were submitted to them on the 11th inst.

Devonport.—The electrical engineer has reported on the visit of a deputation to various towns. He also submitted tenders which the deputation had received from various manufacturers, and the committee selected the following tenders:—An engine by Browett, Lindley & Co., at £950. A traction generator by the Electric Construction Company, at £900. A boiler by Babcock & Wilcox, at £558. The matter was referred to the chairman, the Mayor, Councillor Harrison, and the electrical engineer, with power to act. It was decided to advertise for tenders for the erection of a chimney stack.

Greenock.—The electrical engineer has prepared a report with reference to the method of charging for supply. In it he recommends that the charge per unit for short-hour consumers should be 5½d., and after a certain consumption at the reduced rate of 2d. per unit.

Grimsby.—With reference to the scheme for supplying electric energy for lighting and tramway purposes, the Local Government Board have written to the Town Council stating that they can only sanction the power of borrowing the sum of £5,066 out of the additional £11,000 required.

Guildford (Surrey).—The Council had a discussion last week with reference to proposed purchase of the undertaking of the Guildford Electricity Supply Company. As the voting was equal, however, no decision was come to, and the matter was again dropped.

Hornsey.—At last week's meeting of the Hornsey District Council a special report of the Electricity Committee was brought up by Mr. Henry Burt, M.C.C., which contains a most exhaustive report upon the proposal to instal the electric light in the parish. Mr. Robert Hammond, M.I.C.E., M.I.E.E., M.I.Mech.E., in his report, dated February 27th, 1900, points out that the provisional order was granted to the Hornsey District Council on July 1st, 1898, and that conferred powers to supply electrical energy for public and private purposes in certain parts of the parish, including practically the whole of the shopping area, and that within six months of July next that supply must be given; though at one time the Board of Trade gave great latitude to local authorities, the municipal trading debates in the House of Commons had made them much more strict, and they now either revoke the orders or threaten to do so unless proof is given that the work is about to be started. If the Council wished to keep the matter in their own hands, they must take early steps in the matter. Mr. Hammond advises that if the order is leased to a company the Council should advertise for tenders. To allow the order to lapse and a company to come in would be unwise, and the Board of Trade would not treat the Council's opposition with much consideration if they opposed a company applying for an order. If, therefore, they did not work the order themselves, they should either arrange with a company to supply them with energy, *i.e.*, be tenants under the order, or transfer to a company on the best terms possible. The first course he opposes, and though not in favour of the second, thinks it better than the first. So far as he could ascertain, no local authority which had laid down its own works had regretted doing so. In such cases where a company obtained an order and the authority afterwards bought, the result was that the capital invested in the companies was £1,003,184, and the amount paid by the authorities for the undertakings £1,693,787.

It would not pay to lay down electric lighting works for public lighting only, but by combining the public with private lighting the cost of public lighting would be considerably diminished if not altogether removed.

Out of 54 undertakings by local authorities which had been in existence for more than three years, 37 yielded a revenue to cover working expenses, interest, and sinking fund charges, and in some cases large sums were set aside for reserve, depreciation, and renewal of plant. Taking the companies, he found three only with deficits, amounting to £2,707 altogether, whilst the profit showed £248,511 spread over 31 companies. The returns showed that the improved lighting of Islington cost £6,190, whilst Hampstead got theirs for nothing and had a surplus of £5,987. St. Pancras got for £1,804 what it would otherwise have to pay £6,000 for. He was of opinion that the cost of electric lighting the district would be covered by the profits of the undertaking. Ratepayers might reasonably contend that it was the duty of the local authority to lay down an undertaking, and that as consumers the ratepayers would certainly be better off under the Council than a company whose first business was to make a profit. The price in London varies from 3·26d. per unit in Shoreditch to 6·44d. at Notting Hill. The average price charged by 44 authorities as against 11 companies was 5d. per unit.

Mr. Hammond outlines a scheme for the compulsory area, and recommended a site near the Hornsey railway station, adjoining that of the proposed public baths, for a generating station. In his preliminary report in November, 1897, he recommended the high pressure alternating system; he now thinks the low pressure system best suited for Hornsey. This would be more economical under the new conditions, and he had fixed the delivery current at the feeding points at an average E.M.F. of 480 volts. This would involve 240-volt lamps. The cost of laying mains would be £6,104, being £2,704 for distribution, £1,937 for feeders, and the balance for trenching. This was for 5,692 yards of distributors, &c., and he suggests another £3,750 for mains for extensions. It was estimated that 6,000 lamps of 8-C.P. would be required, but he suggested that 15,000 should be provided for, and the generating plant for this with pipes, &c., would cost £20,250. The engines would be arranged for 300 KW. This did not include cost of site.

Dealing with public lighting, Mr. Hammond thinks that 45 arc lamps are needed, which with connections, &c., would cost £2,250. A further £3,050 would be needed for meters, fuse boxes, and house connections. These latter are not generally charged for in urban districts. He allowed £500 for engineers' fees for certain purposes, and for incidental contingencies, &c., £3,096. This totals up to £38,500. This is £3,500 more than his estimate of 1897, but the increase is due to the rise in the price of materials. An alternative scheme of 21,000 lamps alight at one time, or from 30,000 to 40,000 lamps on consumers' premises, he estimates at £73,500, which includes public lighting.

The probable financial results if taken on the maximum charge of 7d. per unit for 100 hours per quarter, and then 2d. per unit, which, he thought, would average about 5d. per unit, the result would be an income of £6,119, and for the complete scheme £11,512. The cost of generation and distribution he puts at £3,329 and £5,990 respectively. If the interest and repayment of capital is added, a sum of £2,630 and £4.226 must be added to each, and thus in the first scheme a net profit, after the public lighting had been done, would be made of £160, and in the second £1,764.

Many appendices are attached to the report, which the Committee will at once take into consideration.

As many companies offered to take over the order, the Council communicated with them all, with the result that the British Insulated Wire Company offered to take over the order upon certain terms for a given number of years, with power to purchase at 10 at valuation. It would raise a capital of £50,000 for the purpose, and charge a maximum of 4½d. per unit to private consumers, and 2d. for public lamps, the Council to find the lamps and columns. The Edmundson's Corporation suggested 2½d. for the public lamps, the maximum of 7d. per unit for the first, 4d. for second, and 2d. for every further hour for private lighting. The North Metropolitan Company made offer of the Brighton tariff with various terms in a lease with a clause for the payment of a sum for goodwill if Council took it back at the end of the term.

India.—The Government of India have called for the proposals for lighting Wellington by electricity from the Karteki Falls in connection with the scheme for the utilisation of water-power from these Falls for the cordite factory which is now being built in the Arvenghat Valley, Nilgiris.

Llandilo.—The Board of Trade has issued a provisional order for electric lighting to the Council.

London.—MARYLEBONE.—The Board of Trade has just decided to grant a provisional order to the Marylebone Electric Supply Company, notwithstanding the opposition of the Vestry and the Metropolitan Electric Supply Company. The preamble of the Bill, which will in due course be introduced to confirm the provisional order, will be opposed by the Vestry.

New Ross.—Last week Mr. Handley, of Handley and Shanks, electrical engineers of Dublin, appeared before the New Ross Board of Guardians, by request, with reference to electric lighting of the house. He will prepare an estimate.

Northwood.—The Uxbridge and District Development Syndicate, Limited, last autumn put forward a scheme for supplying electricity for Northwood. The Ruislip Parish Council recommended the Uxbridge Rural District Council to refuse their consent to the scheme, and this they subsequently did so far as this parish is concerned. The electric lighting is to be carried out by a local company.

Nuneaton.—The Board of Trade has granted the electric lighting order, but the sanction of the Local Government Board is still awaited.

Richmond (Surrey).—The Richmond (Surrey) Electric Light and Power Company, Limited, has reduced its charges for lighting current from 7d. to 6d., and for power from 6d. to 4d. per unit, with 25 per cent. reduction in meter rentals.

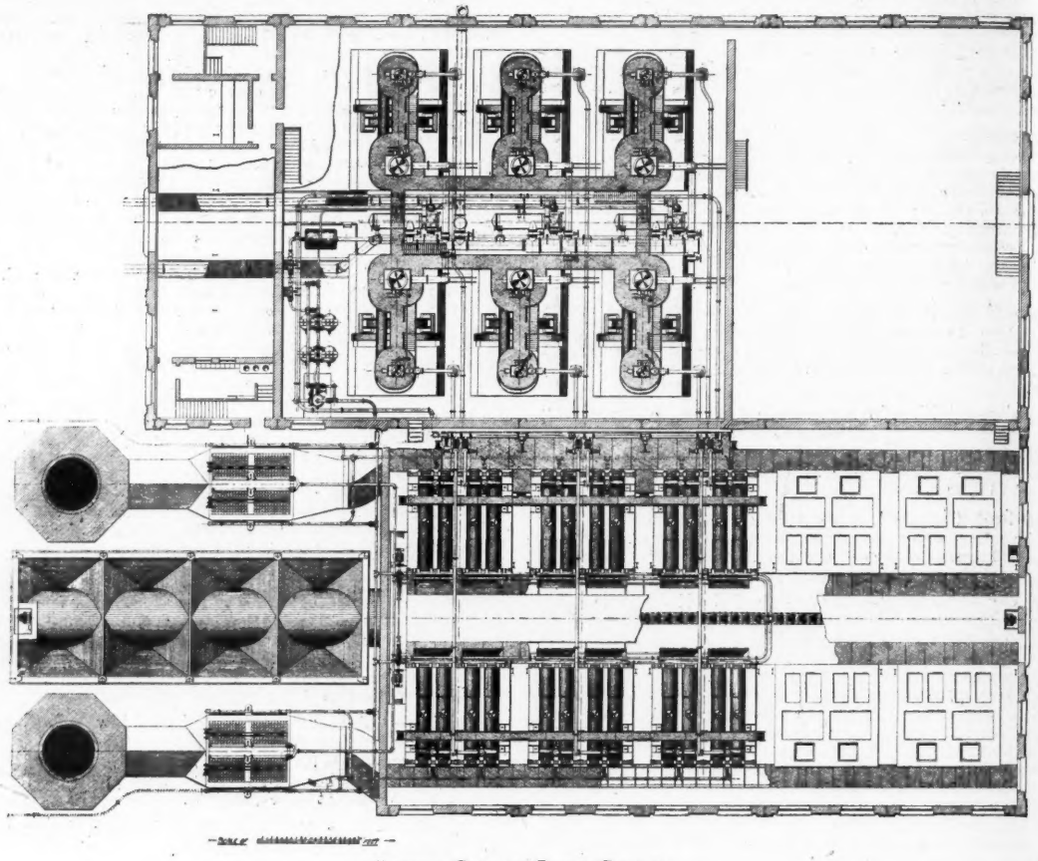
Rickmansworth.—The Urban District Council having considered the letter of Mr. Warden-Stevens with reference to electric lighting, has decided to appoint an Electric Lighting Committee to consider the whole question, and approach various electric lighting authorities as to the most suitable scheme.

Russia.—At the commencement of the present year the central station of the Société Russo-Belge d'Entreprises Electriques was supplying current to private consumers to an equivalent of 115,199 10-C.P. lamps, an increase of 110 per cent. on the year. In addition, current for public lighting was being furnished to 5,084 10-C.P. lamps.

(*Continued on page* 663.)

DUBLIN ELECTRIC TRAMWAYS.

While London is talking about experimental conduits and surface contacts, and from time to time postponing the adoption of an up-to-date system of mechanical traction, the capital of the Sister Isle has been decorated with a system of tramways as yet without an equal in the United Kingdom.



General Plan of Power Station.

The undertaking is the property of the Dublin United Tramways Company (1896), Limited, which was formed in 1896 to acquire the capital of the Dublin United Tramways Company (1881) which owned the existing tramways worked by animal haulage, and of the Dublin Southern District Tramways Company (1878), which owned the Haddington Road to Dalkey line.

The first section of the tramways to be electrically worked was the latter, which runs along the coast, from Dublin through Kingstown to Dalkey, a distance of eight miles. This was fully described by Mr. H. F. Parshall in a paper read before the Institution of Civil Engineers in February 1898, and a descriptive article was published in the Electrical Review, Vol. 38, June 5th, 1896. The electrical generating station was placed on the route at Ballsbridge, and was specially noteworthy as being the first instance of the application of three-phase transmission to tramway working in Europe. In 1897 the Clontarf line, 4 miles long, was converted to electrical working, and a generating station provided at Clontarf. The growing popularity and importance of the electric system of traction, however, which was spreading over the whole city, made it evident that a more homogeneous and comprehensive scheme was necessary, and it was decided to erect a central power station for the supply of the whole of the tramways existing and about to be constructed. A suitable site was selected on the Grand Canal basin at Ringsend, close to the mouth of the River Liffey, and steps were taken in 1897 to lay down generating plant of about 3,000 KW. capacity.

Specifications and plans having been prepared by Mr. H. F. Parshall, tenders were called for, and contracts placed in the following manner :—

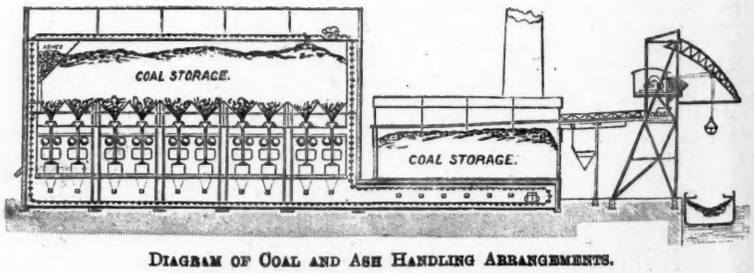


Diagram of Coal and Ash Handling Arrangements.

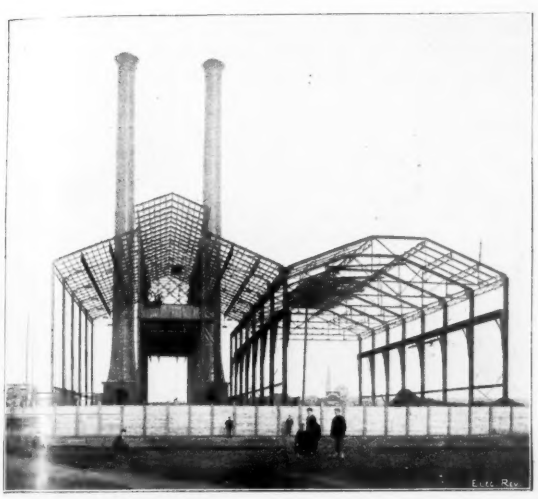
Constructional steel work for buildings and chimney stacks.	Messrs. Riter Conley & Co.
Foundations and brickwork ...	Messrs. H. & I. Martin, Ltd.
Coal conveyor and elevator ...	Messrs. C. W. Hunt Co.
Economisers	Messrs. Green & Sons.
Mechanical stokers	Messrs. Vicars & Co.

The supply and erection of the generating plant and equipment was undertaken by the British Thomson-Houston Co., Limited, the following being the list of sub-contractors :—

Boilers	Messrs. Babcock & Wilcox, Ltd.
Engines	The E. P. Allis Company.
Steam, exaust, and feed piping.	The Crane Company.
Condenser and feed pumps.	The Wheeler Condenser and Engineering Company, Limited.
Overhead travelling crane...	Messrs. Higginbotham & Mannock.
Generators, switchboards, and auxiliary apparatus.	The British Thomson-Houston Co., Ltd.

The outside work, consisting of rolling stock, overhead work, and cables, was allocated as follows :—

Cables and cableways ...	The National Conduit and Cable Co., Ltd.
Car equipments	The British Thomson-Houston Co., Ltd.



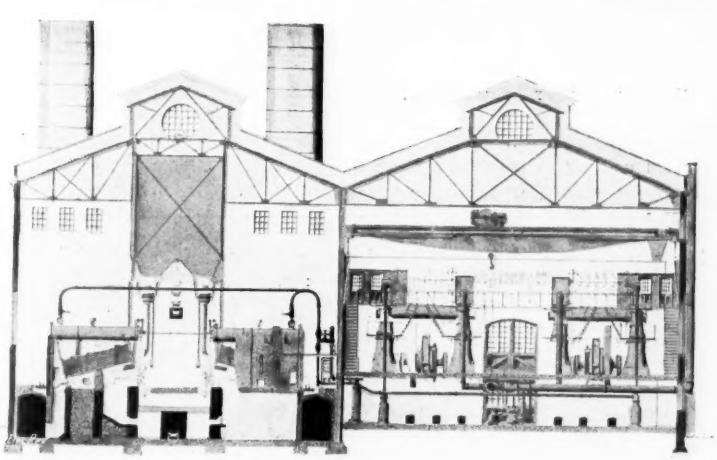
View of the Station, October, 1898.

Fifty of the car bodies were supplied by the British Thomson-Houston Company, and the same number by the City of Dublin Wheel Works, and the remainder were built at the company's own works at Inchicore.

The overhead line work and bonding was carried out by the Tramway Company, the material being supplied by Messrs. R. W. Blackwell & Co.

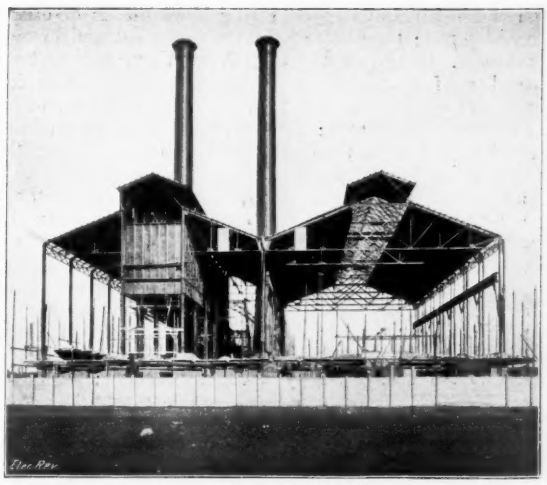
We propose first to describe the power station, and afterwards to give particulars of the tramways.

The buildings consist of two main bays, one housing the boilers and coal storage, and the other containing the generating and distributing machinery. The boiler house measures overall 76 feet × 127 feet in plan, with a clear headroom of 39 feet. Provision is made for two ranges of boilers, with coal bunkers over the alley between them. The height from the floor to the bottom of the bunkers is 25 feet.

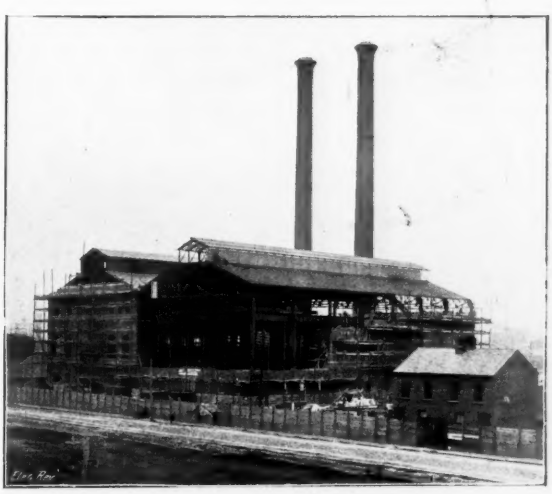


Cross-Section of Generating Station.

The engine room measures 80 feet × 185 feet overall, with a height of 35 feet from the floor level to the bottom chord of the roof principals; the floor level is itself 12¼ feet above the level of the ground outside. The highest point of the open lanterns on top of the buildings is over 80 feet from the ground level.



View of the Station, January, 1899.



View of the Station, June, 1899.

The framework of the buildings is constructed entirely of steel, of which over 600 tons was employed. The steel used is specified to have an ultimate tensile strength of about 30 tons, with a minimum elongation of 20 per cent. in 8 inches. The roofs are of steel, covered with hollow terra-cotta tiles (3 inches thick) followed by felt and slates.

The views which we give of the steel skeleton of the buildings, in October, 1898, and January, 1899, show clearly the system of construction; from these, and from the cross-sectional view of the works, it will be seen that the lantern of the boiler house is specially designed so as to accommodate the coal conveyor over the top of the bunkers.

The latter are floored with ⅜ inch steel plate, arranged in the form of a hopper over each boiler; the side plating is ¼ inch thick. At the southern end a compartment is provided for the reception of 160 tons of ashes. The bunkers have a

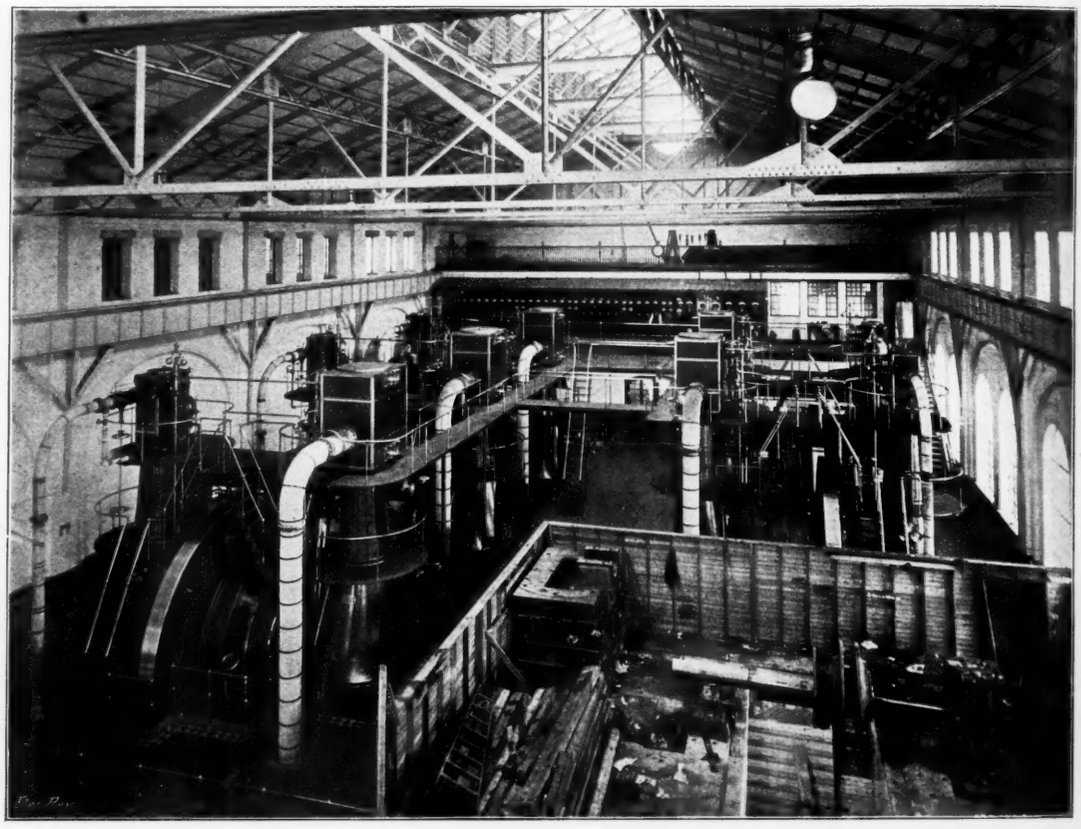
capacity of 1,200 tons; a similar bunker is provided outside the northern end of the boiler house in which a further amount of 800 tons can be stored.

The coal-handling and conveying apparatus is of exceptional interest; the whole of this was supplied and erected by Messrs. C. W. Hunt Co., New York, who make a speciality of coal-handling machinery. The coal, which consists of small peanuts, is brought to the quayside, under the coal tower, in barges; the grab, which holds 1 ton, raises it, and at the same time automatically brings it over the hopper and weighing machine. The coal is dropped into a small wagon with sloping sides, in which it is weighed; the wagon then runs along an inclined railway by gravitation, until it meets a tripping block, which opens the sides of the wagon, and allows the coal to fall into the bunker. The tripping block can be drawn along over the bunker by means of a rope to any point where it is desired to dump the coal. Directly the wagon is relieved of the weight of coal, it is drawn back again to the coal tower by a counter weight; the whole series of operations, from hoisting the coal to the return of the empty truck, is entirely automatic, except the recording of the weight of coal.

The diagrammatic view which we give of the coal-handling and storing gear shows that the conveyor runs under the auxiliary coal store, under the boiler house floor, up to the main coal bunkers, and back over the top of the coal to the starting point. The conveyor is driven through pawls and treble reduction gears by a B.T.H. M.P.-type 10-H P. slow speed motor at a speed of 45 feet per minute, at which rate it is capable of carrying 50 tons per hour into store. The conveyor is of the gravity-bucket type, and is carried by flanged wheels, of which there are four to each bucket, running on steel rails 25 inches apart; the latter are suitably curved where the direction of motion of the conveyor changes from horizontal to vertical, or *vice versâ*, and provision is made at the northern end of the travel for taking up slack. The buckets are of $\frac{1}{8}$ inch steel plate, spaced at 28 inches centres, about 220 in number, and are each capable of holding 2 cubic feet, or about 100 lbs. of small coal.

A singular device is the mechanical filler, of which we give a view. Its purpose is sufficiently obvious from the illustration. The filler can be moved along to any desired point under the coal store, and is automatic in its operation; spouts and valves are provided at suitable points, by means of which the coal may be fed to the conveyor. At intervals of about 12 feet along the line of rails over the main bunkers are dumping levers, to distribute the coal as required. These are extremely simple, engaging with a cam on each bucket, and causing it to tip its load as it passes by.

The same conveyor is used for the removal of ashes and clinker from beneath the boilers. They are carried up to the receptacle at the end of the coal bunkers, which is capable of holding 160 tons, and are automatically dumped there; they are eventually loaded into an electrically equipped truck by means of a shoot leading to the outside of the building. We give a view of the pushing gear, which shows how the pawls are automatically applied to the pins, and removed therefrom by a fixed cam acting on the projecting heels of the pawls; the ingenious manner in which this is done, ensures that there shall be no wear on the spindles, and we understand that the whole apparatus works quite silently and satisfactorily. The motor is operated by means of a B.T.H. auto-starting rheostat with over and underload attachment.

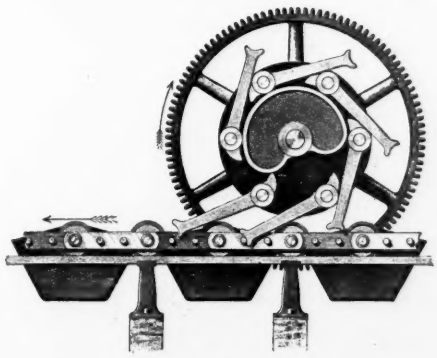


General View of Engine Room.

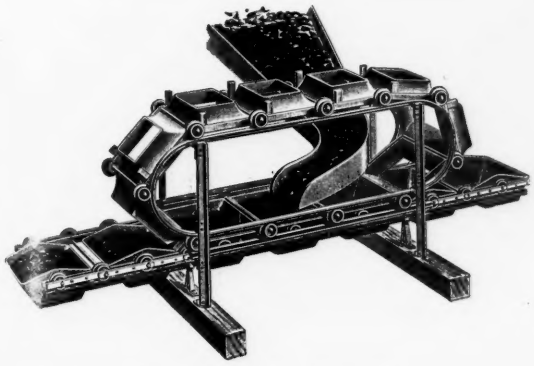
From the bunkers the coal falls into vertical shoots, one in front of each boiler; here again the apparatus presents marked features of divergence from English practice. The shoots are borne on wheeled carriages running on rails, so that they can be drawn aside out of the way or moved about to distribute the coal in the hoppers below; they are also provided with a system of levers by means of which they can be weighed, with their contents, and the weight indicated on a steel yard enclosed in an iron case conveniently placed near the boiler fronts. The shoots and dials are clearly seen in our illustration of the boilers, together with the chains, by means of which the valves in the bunkers are controlled and the shoots moved to and fro; each shoot holds about 8 cwt. when full, and can be emptied as required by means of a valve at the lower end. It will be noticed

that the coal is weighed twice between the barge and the boiler furnace.

The boilers at present installed consist of six batteries of two each, or 12 in all, of Messrs. Babcock & Wilcox's usual type; they contain 2,530 square feet of heating surface each, and are equipped with Vicars mechanical stokers and grates. The latter are driven from underground shafts by means of



Driving Mechanism of the Coal Conveyor.

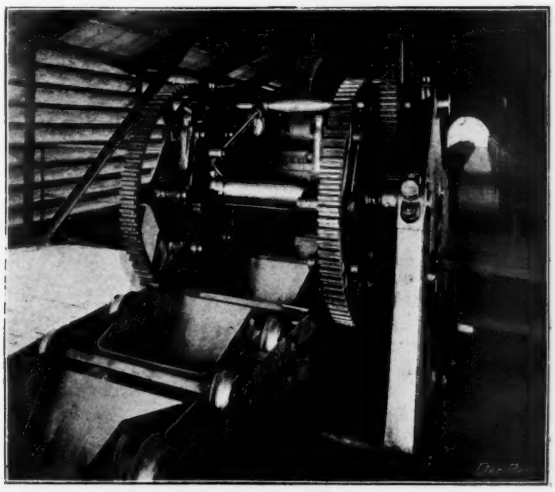


Spout Filler for Conveyor.

two Chandler high speed compound enclosed engines, which serve as stand-by for one another. There is room for eight additional boilers, the foundations for which are already laid. The boilers are tested up to 250 lbs. per square inch, for a working pressure of 160 lbs.

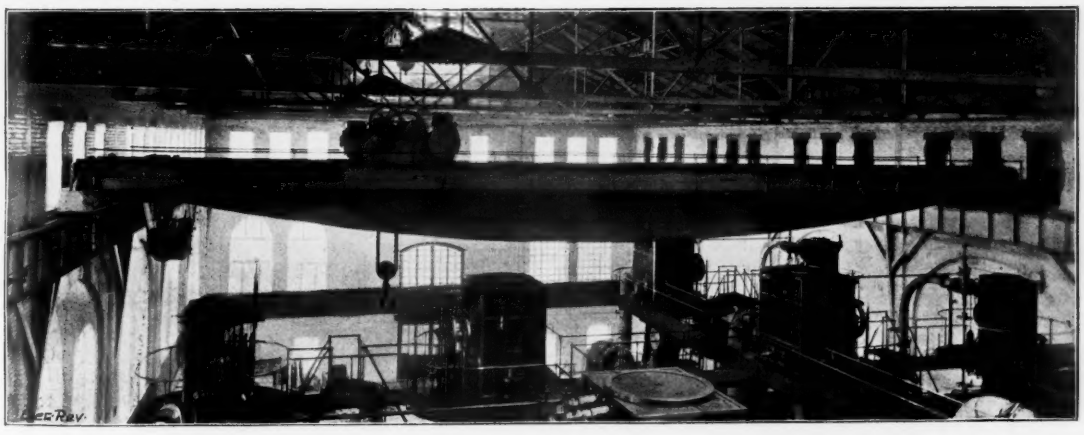
extending between the two economisers, so that either motor can be used to drive the whole of the scrapers.

The steel chimney shafts are of great interest; they are 230 feet in effective height, from the bottom of the flue to the top of the shaft, 12 feet in diameter overall, and 10 feet in diameter inside the firebrick lining. The foundation consists of a concrete block 14 feet deep and 29 feet square, resting on a hard gravel bed; upon this is an octagonal brick base, the total height of this part being 30 feet. A heavy baseplate of cast-iron, in eight parts, is fixed to the concrete by



Driving Gear of Conveyor.

means of holding down bolts; to this the steel shell is riveted. The shell plates are $\frac{3}{8}$ inch thick for the first 50 feet; $\frac{5}{16}$ inch thick from 50 feet to 110 feet; and $\frac{1}{4}$ inch thick from 110 feet to the top, which is 200 feet above the baseplate. The shaft is built of steel plates in rings, lap-jointed, and tapering upwards, and is surmounted by an ornamental cap of galvanised iron, No. 14 B.W.G. The horizontal seams are double riveted for a height of 40 feet; all other seams are single riveted, with $\frac{3}{4}$ inch and $\frac{5}{8}$ inch rivets. A steel ladder is fixed to the shaft, and passes up through a door in the cap. The chimney is lined throughout with firebricks, specially moulded to fit the shape of the shell, and laid in fireclay.



Electric Crane.

The waste gases are conducted by means of two flues, one on either side of the boiler house, to the economisers and chimneys. The economisers are of the Green type, arranged in two groups of 192 tubes each in each flue; the tubes are of standard size (9 feet × $4\frac{9}{16}$ inches), put up in 24 sections of eight per group. The scrapers are driven by two B.T.H. motors, type C E; these are provided with a countershaft

The weight of steel used in the construction of each of the shafts is 50 tons, and they are stable against a wind pressure of 25 lbs. per square foot without receiving any support from the holding-down bolts. It is of interest to know that each of these shafts was erected *in three weeks!*

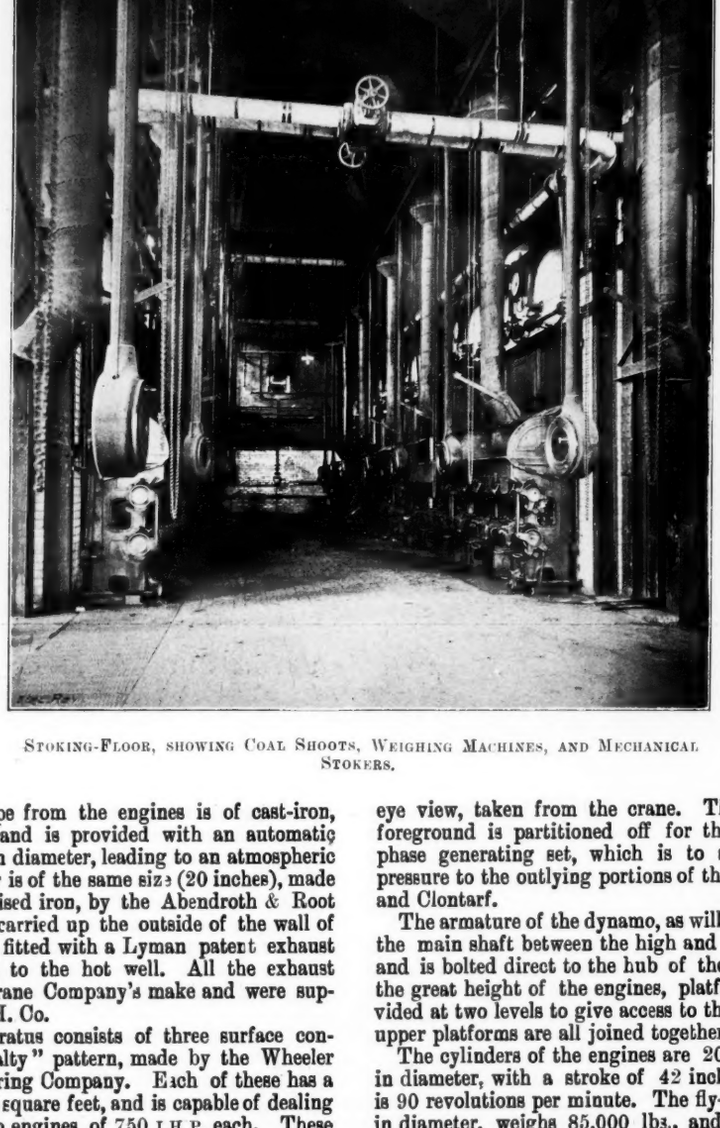
The whole of the steam pipes were supplied by the Crane Company, and are of lap-welded steel. They are guaranteed to

stand a test pressure of 800 lbs. per square inch, or to work at 250 lbs. pressure. The system of steam distribution is as follows:—Each pair of boilers is connected by a single steam pipe with one engine. There is no duplication, and no ring, the idea being that a certain boiler unit shall in general feed a certain engine. To provide for eventualities, however, each of these pipes is connected by a T with an equalising steam pipe, which runs across the whole range close to the boiler house wall. By means of this pipe steam can be carried from any boiler to any engine, but as this is normally almost idle, its diameter is but little greater than that of the direct steam pipes—in fact, no pipe is of greater diameter than 12 inches.

The feed pumps are of the Blake & Knowles type, each capable of delivering 8,000 gallons of water per hour, *i.e.*, to feed the whole of the boilers. The water is drawn from the hot well, and is passed through two oil filters of Messrs. Raylton, Campbell & Dixon's manufacture before going into the economisers.

The exhaust steam from the auxiliary engines passes through a Wheeler feed water heater on its way to the condensers. The make-up water is obtained from the town mains; a tank is being erected to store a sufficient quantity, while alternatively water can be obtained from the canal basin.

The steam pipes, as will be seen from the cross-sectional view of the works, dip down beneath the floor of the engine room; a Stratton steam separator, made by the Crane Company, is fixed by the base of each engine to intercept water of condensation. All the separators are drained to a battery of traps delivering to an automatic pump, which returns the water direct to the feed pipes without passing through the hot well.



Stoking-Floor, showing Coal Shoots, Weighing Machines, and Mechanical Stokers.

The main exhaust pipe from the engines is of cast-iron, 30 inches in diameter, and is provided with an automatic relief valve, 20 inches in diameter, leading to an atmospheric exhaust pipe; the latter is of the same size (20 inches), made of spiral riveted galvanised iron, by the Abendroth & Root Company, N.Y., and is carried up the outside of the wall of the engine room. It is fitted with a Lyman patent exhaust head, which is drained to the hot well. All the exhaust pipes, &c., are of the Crane Company's make and were supplied through the B.T.H. Co.

The condensing apparatus consists of three surface condensers of the "Admiralty" pattern, made by the Wheeler Condenser and Engineering Company. Each of these has a cooling surface of 2,400 square feet, and is capable of dealing with the steam from two engines of 750 I.H.P. each. These condensers, which we have described on other occasions, are built above their air and circulating pumps, and consist of cast-iron shell, with brass tubes. The steam cylinders are 7 inches and 14 inches diameter, the air-pump barrel 16 inches, the water pump 18 inches, and the stroke in all cases is 16 inches. Circulating water is obtained from the dock, the intake being through roses in two separate chambers. Either of these can be cut off by means of a stop-valve, or can be closed from the dock and pumped dry if required.

The engine room is extremely lofty, well lighted, and lined with glazed bricks; it is provided with a runway at a height of 27 feet above the floor level, upon which runs the travelling crane. The latter was made by Messrs. Higginbotham and Mannock, of Manchester, and was also part of the British Thomson-Houston Company's contract; it is of 76 feet span, and is capable of lifting a weight of 25 tons at a speed of 4 feet per minute, with a quick lift of ½ ton at 50 feet per minute, while the longitudinal and cross traverse is effected at 60 feet per minute, fully loaded. The crane is electrically operated, there being three G.E. 800 motors for hoisting and travelling, and for the cross traverse of the crab; the motors are all of the G.E. enclosed railway type, and are operated by means of controllers mounted in a cage. Power is supplied to the crane by means of a trolley wire fixed to the gantry girders, upon the upper side of which runs a trolley wheel; six bare copper conductors, three fixed on either side between the crane girders, convey the power to the two motors on the crab. The return circuit is effected *viâ* the ironwork of the building, current being obtained from the main bus bars. An automatic brake is provided, which holds the lifting gear whenever current is cut off from the motors.

The engine room at present contains five generating sets, each consisting of a 550-KW. railway generator, supplied by the British Thomson-Houston Company, Limited, direct driven by a cross compound vertical engine, made by Messrs. E. P. Allis & Co., of Milwaukee. These are shown in our bird's-eye view, taken from the crane. The space on the right foreground is partitioned off for the erection of a three-phase generating set, which is to supply power at high pressure to the outlying portions of the lines, towards Dalkey and Clontarf.

The armature of the dynamo, as will be seen, is mounted on the main shaft between the high and low pressure engines, and is bolted direct to the hub of the fly-wheel. Owing to the great height of the engines, platforms have to be provided at two levels to give access to the valve gear, &c.; the upper platforms are all joined together by gangways.

The cylinders of the engines are 20 inches and 40 inches in diameter, with a stroke of 42 inches; the normal speed is 90 revolutions per minute. The fly-wheel, which is 19 feet in diameter, weighs 85,000 lbs., and is built up of eight segments, each comprising one arm and one-eighth of the hub and rim; these are bound together by quadruple steel rings shrunk on the hub, and may be run at full speed without other attachment! For additional security, however, they are tied together by wrought-iron links shrunk on projections in the rim. The shaft is 19 inches

diameter in the hub of the fly-wheel, and 17 inches in the bearings, which are 33 inches long, lined with Babbitt metal.

The valve gear is of the Reynolds-Corliss trip type, with automatic cut-off on both cylinders; this is controlled by a governor of the fly-ball pattern, while the low pressure cut-off is also adjustable by hand while the engine is running. The variation in steady speed between no load and full load is guaranteed not to exceed 1¾ per cent. An emergency governor is also provided, which shuts off steam absolutely from the engine if the speed, from any cause, rises to 95 revolutions per minute.

The engine is so arranged that, in case of need, it is possible to run either the high or low pressure side independently with a load of 600 I.H.P.

Sight feed lubrication is in use, but an automatic system is about to be applied to the whole of the engines.

The guaranteed efficiency of the engines under normal working conditions at full load of 630 B.H.P., is 1 I.H.P. per 12·7 lbs. steam per hour. At 800 I.H.P., the steam consumption per I.H.P. is to be not more than 13·25 lbs. per hour. The average of one week's running has been shown to result in a consumption of 4·72 lbs. coal per KW.-hour—a result which will be regarded with pardonable envy by engineers in charge of lighting stations!

(To be concluded.)

ELECTRIC LIGHT AND POWER NOTES.

(Continued from page 657.)

St. Albans.—The Town Council have decided not to do anything as regards electric lighting for the present.

St. Pancras.—The accounts of the St. Pancras electricity undertaking for the year ended Dec. 31st, 1899, were presented to the Vestry at their meeting on Wednesday last week. The year's trading has proved very successful. The gross revenue for the year amounts to £44,880 7s., an increase over the previous year of £6,624 6s. 8d., and the net profit, after payment of instalments of loans and interest charges, £6,841 19s. 11d., an increase of £2,666 17s. 6d. To the net profit for the past year must be added £1,892 9s. 7d. brought forward from 1898, which leaves a profit of £8,734 9s. 6d. to be disposed of. It is proposed to dispose of this balance as follows:—To write off £1,600 for depreciation of accumulators, meters, switches, &c.; to contribute £2,000 in aid of the lighting rate, and to transfer £4,000 to the reserve account, which will now amount to £12,000, leaving a balance of £1,134 9s. 6d. to be carried forward to next year's accounts. The Vestry have every reason to congratulate themselves on the results achieved, especially considering that a sum of £6,536 16s. 6d. has been allowed as rebate off the accounts of consumers charged by the maximum demand indicator system. Having regard to the satisfactory results obtained, it is proposed to considerably reduce the charges both for private and public supply after June quarter, so that private consumers not using the maximum demand indicator will be charged 5d. instead of 6d. per unit, and those using the indicator will be charged 6d. a unit for the first hour and 2d. per unit for all after, instead of 6d. and 3d. respectively. The supply for motive power will be reduced from 3d. to 2d. a unit, and for street lighting from 4d. to 3d.

South Africa.—The *British and South African Export Gazette* says that:—

"The progress evinced in the consumption of electricity for lighting and power purposes in all South African centres where it has been introduced also characterises that of the Cape metropolis, and the increased demand induced by the normal, and at present abnormal, growth of the population has had the natural effect of rendering continuous additions to the plant necessary. The new "Economic" boilers which are about to be put down at the Central Station, are being supplied by Messrs. Davey, Paxman & Co., Limited, Colchester, and will be fitted with the Meldrum forced draught furnaces, made by Messrs. Meldrum Bros., Manchester, which, besides increasing the duty from the boilers, obviate smoke and economise fuel. The merits of these furnaces are well known in South Africa, they being largely used on the Rand, in Natal and elsewhere.

"The public reception of the boon of electric lighting at East London has been such that within three months of the starting of the service the estimate of the possible needs has been vastly overstepped, and the necessity for a considerable increase of the plant has become apparent. The additions now proposed are the acquisition of a 65-KW. alternator with engine combined, at a cost of £1,500; the necessary boiler connections and additions to switch-board, £150; automatic switches with connecting circuit, £700; and a smaller engine and alternator than the above. The acquisition of 30 high tension fuse boxes at a cost of £3 10s. each, is also recommended. It is not considered that these represent the final demands.

"The electric tramways at East London installed a couple of months ago, have already proved such a success that contracts for the construction of additional cars are being placed, some to be exclusively for native use."

For the electric lighting plant of the South African Mutual Life Insurance Company's premises at Port Elizabeth an order for two 50-H.P. locomotive boilers, and two 10 × 8 high-speed engines has been given to the Royal Electric Company, of Montreal, Canada.

Southampton.—The Electricity Committee is to advertise forthwith for tenders for the construction of the additional boiler required at the supply station. Alderman Bone said at the last Council meeting that it was absolutely necessary that they should make some provision for their output next winter.

Sudbury.—The Council's provisional order has been reported for second reading.

Tyneside.—The Willington Quay District Council has rescinded its resolution opposing the Tyneside Electric Power Company's Bill, and is now content to allow the company to come into the district if it wishes to do so.

West Hartlepool.—A Darlington paper commenting regarding the West Hartlepool electric lighting scheme, says that the work in connection with that luckless generating station, Alderman Wilson regretfully admits, does not make headway, and the probabilities are that the job will have to be taken out of the contractor's hands. The plant and other accessories have long ago been ready. One result of this delay has been to considerably enhance the cost of the work, on account of increased cost of materials and labour. Meanwhile the demand for the supply is steadily increasing.

Weybridge.—The Board of Trade has granted the provisional order applied for by the Urban Electric Supply Company, Limited.

Wigan.—At a recent Council meeting, Mr. Worthington, in moving the confirmation of the minutes of the Electric Light and Tramways Committee, said although the minutes covered a very large space they were mainly concerned with the letting of contracts. The whole of the contracts necessary for the completion, not only of the power house, but of the tramway from Martland Bridge to Market Place were let, and the work was in hand; and he believed they might expect that almost immediately after the power house was roofed in the whole of the machinery would be ready for delivery. The committee felt justified in recommending to the Council the purchase of the remaining land between the present site of the power house and Bradford Street.

Alderman Holmes asked why they had thought fit to make a reduction in the price of the current as given in the minutes—"Moved by Mr. J. Gee, seconded by Mr. Wood, and resolved that the arrangement to supply current at ¾d. per unit for a 24 hours' load be adopted." On the terms that were originally laid down in October last, and had since been circulated in the town, the maximum demand for motor heating or special purpose was 12 hours and above 1d. per unit. They counted 12 hours and above to mean 24 hours, and what was the reason that the price was reduced 25 per cent.

Mr. Worthington said that when the list was drawn up for 1d. per unit, it was never dreamt that there would be anybody who would make application to them for the current to be used the whole of the 24 hours' running for motive power, but almost before they had commenced operations they had such an application, and on working it out he might say that they would make more money if they put the price at ¾d. per unit for a 24 hours' running than they would at 1d. per unit for 15 hours' running, because the men, the steam, and the attendants would be there the 24 hours, whereas in the 15 hours' running they would not be getting anything for the nine hours remaining, though they would be there the same. Consequently on figuring it out they found it was better to supply the current at ¾d. per unit for 24 hours' running.

Windsor.—The Queen has given orders (says *Truth*) that St. George's Chapel, Windsor Castle, and the Albert Memorial Chapel are to be lighted by electricity.

Worcester.—Rather than go to litigation over the matter, the Council is paying £75 to meet the claim of a Mr. Thomasson for injuries received from a fall into a transformer chamber.

The Electricity Committee has for some time been considering the necessity for providing in the near future a supplemental generating station. Negotiations for a site are proceeding. When the Council came to consider the question last week, Ald. Caldicott moved an amendment that—

Before the Council incurs the expense involved in the resolution, the Electricity Committee submit a full report as to the advisability of constructing a generating station in the city, with an estimate of the probable cost and the annual maintenance thereof, and also a statement of the total number of units which could have been generated by water-power at Powick during the years 1898 and 1899 respectively, assuming that there had been a full demand for the current.

The amendment was rejected.

ELECTRIC TRACTION NOTES.

Berlin.—An electric tramway connecting the extreme north with the extreme south of Berlin, was opened on Sunday. The length of the line is 15,180 metres.

Blackburn.—We read that the electric trams have been a wonderful success at the reduced fares. So great is the pressure, indeed, that it has been decided to double the lines in the busy places in order to cope with the traffic. When the double lines are completed, it is intended to run a five minutes' service.

Bolton.—The official statement of the working of the electric tramways during the month of March shows the total number of passengers carried to be 939,908, and the receipts £3,916. The statement in regard to the working expenses from January 1st to March 31st shows the expenditure to be £7,280, but as this includes £1,088 for uniform, the actual expenditure is £6,191. The total receipts amount to £10,543 18s., leaving a balance of £4,351 for the payment of interest, &c. The total passengers carried since the opening of the system numbered 2,530,536.

A jury at the Salford Hundred Court of Record has just awarded an earthenware dealer £40 damages against the Bolton Corporation on account of injury to his horse and damage to the cart by an electric car running into them.

Liverpool.—This week the work of laying the tramway lines for electric traction will be commenced on another section, namely, along Victoria Road and Derby Road to the Bootle borough boundary. Up to the present nearly 50 miles of single, or 25 of double lines have been laid for electric cars. This year more than 10 miles of single line have been dealt with. Altogether a total of 68 miles of horse-car lines have to be converted, and 24 miles of additional lines laid.

Manchester—Liverpool.—The *London Gazette* for 10th inst. contains notice of application by the promoters of this electric express railway scheme for additional provision to authorise lateral deviations and alterations of levels of the railway proposed to be authorised by the Bill now pending in Parliament.

Metropolitan Railway.—The *City Press* says that the board of the Metropolitan Railway Company hope to be able to run their first electric train a few days hence. It is to consist of six carriages, 3 inches wider than those at present in use, and will provide accommodation for 312 passengers.

Nidderdale.—A public meeting was held at Lofthouse, near Pateley Bridge, last week, to consider an offer of the Power and Traction Company, Limited, to construct a light railway from Pateley Bridge to Lofthouse, a distance of seven miles. Mr. Smith, a director of the company, attended, and said that the valley had been surveyed, and the company recommended that a 2 feet 6 inches gauge line should be laid along the north side of the valley, with stations at Pateley Bridge, Wath, Ramsgill, and Lofthouse. The preliminary expenses in obtaining Parliamentary powers, &c., would probably be about £1,000. If residents would subscribe £500 the company would find the remainder, and if the line was proceeded with the £500 would be returned in shares.

Portsmouth.—The Tramways Committee of the Town Council, having received a letter from the solicitors to the tramways company, formally declining to submit the points in dispute to Sir F. Bramwell, who has been appointed arbitrator to determine the sum to be paid for the undertaking, it has been resolved to apply to the Queen's Bench Division of the High Court for a mandamus against the company. The necessary action was accordingly initiated by the town clerk (Mr. A. Hellard), and on Tuesday last week a rule *nisi* was granted.

TELEGRAPH AND TELEPHONE NOTES.

Australian Cable Matters.—Reuter's Melbourne agent says that the Postmasters-General of New South Wales and Victoria will attend the Premiers' conference in view of the settlement of cable questions.

Bristol Telephones.—The report of the Bristol Chamber of Commerce to be presented to the annual meeting of members next week contains a summary of the telephonic work done in the district. This states that the Bristol exchange is necessarily in a transition state at present. The new building in Telephone Avenue is now complete, and has been occupied for some time. The underground work, which will enable the company at an early date to transfer the subscribers to the large new switchroom, is practically completed, and the delicate process of bringing the ends into the new building and of testing and connecting them with the new switchboard is also nearly finished. It is hoped that in the month of May all this work will be completed, and that the various improvements in the new switchboard, and in other material points, will lead to Bristol having an unsurpassed telephone service. Exchanges have been opened at Chippenham and Warminster, and arrangements are almost complete for opening at Dursley and Berkeley, at Wellington and Felton. Radstock and Midsower Norton may soon follow. The Post Office trunk service has at last been brought to Swindon. At Bath the underground work is nearly complete, and more than two-thirds of the subscribers are now connected with the system on metallic circuits. At Gloucester all the pipes for the underground work are now laid, and the work of drawing in the cables is being pushed forward. In the West of England and in South Wales continued progress has been made in the number of subscribers, the opening of new exchanges and the extension of underground work. At Swansea, where a change of offices had become necessary, very eligible premises have been secured in one of the best situations of the town; this will be a great improvement. The number of subscribers of the National Telephone Company had increased from 120,144 at the end of 1898 to 140,600 in 1899.

Cable Rates to Australia.—Reuter's Melbourne agent telegraphed on 16th inst.:—"The Governments of South Australia, Western Australia, and Tasmania have signed an agreement with the Eastern Telegraph Company by which the reduced tariff of 4s. a word will come into force on May 1st. The present rates for the other Australian colonies will be maintained unless the approaching conference of Premiers arrives at an understanding with the company."

Channel Cable Cut.—The *Boulogne Times* says:—Mr. S. H. Muntz, German Vice-Consul, informs us that the German-English telegraph cable was cut in proximity to Boulogne on Monday. It is thought to be the work of a Boulogne smack. The delinquents, notwithstanding a reward of 500 francs (£20) offered by the German Government, have not yet been discovered, although Mr. Muntz, assisted by the local police, is having all smacks entering the port closely examined. It will be remembered that a similar mischance befell this cable about a year ago. The cable will take three days to repair, which means a loss of 90,000 francs (£3,600).

German Telephones.—Development of the telephone service in Germany (writes the *Daily Chronicle* Berlin correspondent) continues to make remarkable progress. In a few days direct communication will be opened between Berlin and Basle. The German postal authorities are in treaty with the Swiss and Italian Governments with the object of still further extending direct communication with Switzerland and Italy. It is expected that at the end of this year it will be possible to communicate with Rome, a distance of over 1,000 miles.

The London to Birmingham Cable.—Last week the last length of the underground telegraph cable between London and Birmingham, which the Post Office has been laying since January, 1897, was completed. Readers will remember an illustrated article which appeared in the Electrical Review for January 27th, 1899, in which particulars of this cable were given.

Rosario Telephones.—The *Review of the River Plate* says that the representative of the English syndicate is at present in Rosario in treaty with the authorities for establishing a new telephone company in that city, the wires to be underground. "In view of the fact that it is impossible to use the existing telephones in Rosario when the electric light is working, the new company should have a first class opening and is sure to be received with open arms by the public in general in that city."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1891 duplicate)	Oct. 23, 1899 ...	...
Trinidad-Demerara (1871 original)	Apl. 14, 1900 ...	...
Mole St. Nicholas-Cape Haitien...	March 6, 1900 ...	...
Zanzibar-Mombassa...	Apl. 10, 1900 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Cayenne-Paramaribo	Feb. 16, 1900 ...	...
Ceara-Maranham	Feb. 20, 1900 ...	...
Para-Maranham	March 2, 1900 ...	...
Coro-Maracaibo	Mar. 15, 1900 ...	Apl. 14, 1900
Latakia-Cyprus	June 20, 1899 ...	...
Sitia-Rhodes...	Apl. 6, 1900 ...	...
Tarifa-Tangier	Jan. 2, 1900 ...	...
Landlines.		
West Indies:—		
Haitien landlines	Apl. 12, 1900 ...	Apl. 14th, 1900
South African:—		
Communication with Mafeking and beyond	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
Communication beyond Burghersdorp (Cape of Good Hope) ...	Nov. 7, 1899 ...	...
Communication beyond Estcourt (Natal)	Nov. 7, 1899 ...	...
Communication with all offices of Colombia beyond Buenaventura...	Jan. 22, 1900 ...	...
Communication "*vid* Hanekine" interrupted on Persian Territory	Feb. 24, 1900 ...	...
Coro-Maracaibo	Mar. 15, 1900 ...	Apl. 14, 1900
Serena-Valparaiso	Jan. 16, 1900 ...	Apl. 12, 1900

Turkish Telegraphs.—Reuter's Constantinople representative says that, according to the newspapers, the Sultan has offered an extension of the telegraph cable from Essalt to the Hedjaz, a distance of 2,500 kilometres. The expense of the extension will be defrayed from the civil list.

The U.S. Pacific Cable.—Reuter's Washington agent, telegraphing on 11th inst, stated that the Senate had passed a Bill for the Pacific cable to be under the control of the Navy Department. $300,000 have been appropriated to begin the work.

The Telephone in London.—Mr. W. Heinemann, of 21, Bedford Street, W.C., sends a copy of the following letter, which he has received from the National Telephone Company, to the *Times*. He says:—"It really requires no comment; the indignation we all must feel will be too readily understood. The telephone is a necessity of modern life, as much so as water and light, and it seems monstrous that even the threat should be possible that taxpayers (and business men to boot) should be deprived of it, either through the incapacity of the company, or the red tape of the London County Council or the pompous extortion of one individual landlord."

The National Telephone Company, Limited, 34 and 35, Gerrard Street, Soho, London, W., April 12th, 1900.

Wm. Heinemann, Esq., 21, Bedford Street, Strand, W.C.

Dear Sir,—I regret to inform you that the lessees on the Bedford Estate, who for many years have granted the company wayleaves, are now being compelled by the estate authorities to give notice to the company terminating their agreements, with the only alternative of an absolutely prohibitory payment to the Bedford Estate for wayleave rental. Under these circumstances the company, unless this arrangement can be modified, will have no option but to remove the whole of the wires, and I think it only right to call your attention to this at the earliest possible moment, so as to enable you to make whatever arrangements may be necessary.

I can assure you that it is with the greatest regret that the company will have to put you to this inconvenience, but, owing to the refusal of the London County Council to allow further underground work and the Bedford Estate to allow overhead wires on reasonable terms, I see no prospect of being able to continue the service to you.

Yours faithfully,
R. A. Dalzell, District Manager.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aarhus, Denmark.—April 30th. Tenders are invited for the delivery and laying down of the network for distribution of the current from the electric station in Aarhus. For particulars see "Official Notices" to-day.

Aberdeen.—The Corporation invites tenders for one year's supply of coal for the electricity works, Cotton Street. J. Bell, city electrical engineer.

Barnsley.—Tenders are to be invited by the Council for 13 arc and incandescent lamps and posts for public lighting.

Birkenhead.—April 23rd. The Corporation wants tenders for boilers, economiser, mechanical stoker, steam dynamos, condensing plant, battery and booster, and overhead travelling crane for the tramway power station. See "Official Notices" April 6th.

Dublin.—April 26th. The Electric Lighting Committee wants tenders for six Lancashire and four water-tube boilers and two economisers; two 1,000-kw. and two 500-kw. low speed polyphase generators for the electricity supply scheme. See "Official Notices" March 9th.

Dundee.—April 25th. The Town Council wants tenders for a traction switchboard for the electric station. See "Official Notices" April 6th.

Glasgow.—April 30th. The Corporation are prepared to receive tenders for the opening of trenches and the supplying and laying of underground conduits for telephone cables therein, &c. Specifications on application to Mr. A. R. Bennett, telephone engineer, City Chambers, Glasgow, upon payment of £2 2s. for each specification, which will be returned on receipt of a *bonâ fide* tender. See "Official Notices" to-day.

Glasgow.—May 5th. Tenders for electricity meters are wanted by the Corporation. See "Official Notices" to-day.

Halifax.—The Electricity Committee wants tenders for a year's supply of electricity meters; and the Tramways Committee for the supply of various parts in connection with the overhead equipment of new lines. See "Official Notices" March 30th.

Liverpool.—April 25th. The Select Vestry of the Parish of Liverpool invite tenders for an installation of about 100 lights in connection with the Nurses' Home of the Workhouse, Brownlow Hill, according to a specification which may be seen at the office of the Vestry Clerk, Parish Offices, Brownlow Hill.

London.—April 30th. The Great Eastern Railway wants tenders for stores and materials. See "Official Notices" to-day.

London.—May 22nd. The Central Electric Supply Company, Limited, invites tenders for (1) two 1,200-I.H.P. Willans engines and three-phase H.T. generators (direct-coupled); (2) six three-phase H.T. motors direct-coupled to L.T. continuous current generator; (3) switchboards and connections. Specifications, &c., at the office of Prof. Kennedy. As to conditions and general particulars see our "Official Notices" to-day.

London.—June 1st. The City Corporation Streets Committee invite proposals for the hire of an electrically-driven dust cart. See "Official Notices" this week.

Mariupol.—May. The Secretary of State for Foreign Affairs has received a despatch from H.M. Consul at Taganrog, stating that tenders are invited by the municipality of Mariupol, not later than May 16th (29) next, for the construction and exploitation of an electric tramway and the installation of electric light in that town. Particulars may be examined on personal application at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Perth.—May 7th. The Burgh Commissioners want tenders for 45 enclosed arc lamps, and lamp pillars, with switch gear, &c. See "Official Notices" to-day.

Rhyl.—May 14th. The Council wants tenders for water-tube boilers and other steam plant; steam dynamos, pumps, &c.; switchboard; mains, lamp-posts, &c.; battery; meters; crane, &c., for electricity works. See "Official Notices" to-day.

Southampton.—May 1st. The Corporation wants tenders for a 300-kw. continuous current generator coupled direct to a medium speed vertical compound steam engine for the electricity works. See "Official Notices" April 13th.

Spain.—May 5th. The municipal authorities of Moguer (Province of Huelva) are inviting tenders until May 5th, for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiente de Moguer, Huelva.

Sunderland.—April 27th. The Corporation wants tenders for the supply of two additional switchboard panels with instruments, &c., for the electric lighting station. See "Official Notices" April 6th.

West Hartlepool.—April 24th. The Corporation invite tenders for wiring the electric light station and offices at Burn Road. Specification, &c., may be obtained from Mr. H. F. Frederichs, borough electrical engineer, upon payment of one guinea.

Wimbledon.—April 24th. The Wimbledon Council wants tenders for electric light wiring, fittings, &c., at the new isolation hospital. See "Official Notices" April 13th.

CLOSED.

Barrow.—The tender of Messrs. Babcock & Wilcox for extensions to the steam plant at the electricity works at £4,540 has been accepted by the Electric Lighting Committee.

Glasgow.—The offer of Messrs. Brockie-Pell Arc Lamp, Limited, to supply on hire 920 arc lamps required for the Exhibition, has been accepted.

Hereford.—A committee of the Council have accepted the tender of Mr. A. H. Wood for the electric lighting of the Asylum at a cost of £4,462.

London.—The *Contract Journal* gives the following list of tenders submitted to the Fulham Vestry for the supply of 250 meters:—

	£	s.	d.
British Thomson-Houston Company, Limited (Thomson meter)	£1,277	10	0
British Westinghouse Electric and Manufacturing Company, Limited (Shallenberger meter) (part square)	900	0	0
British Westinghouse Electric and Manufacturing Company, Limited (Shallenberger meter) (all square)	1,300	0	0
Electrical Company, Limited (Hummel meter)	1,250	0	0
General Electric Company, Limited (Aron meter)	1,280	0	0
Johnson & Phillips (Hummel meter)	1,250	0	0
Venner & Co. (Hookham meter) (part round)	861	2	6
Venner & Co. (Hookham meter) (all square)*	1,071	3	6
Witting Bros., Limited (Hummel meter)	1,062	10	0

* Recommended for acceptance.

London.—The following is a list of the submitted tenders for electric light installation at King's College, London. The list is sent to us by Mr. Grant:—

	£	s.	d.
Alliance Electrical Company	1,722	0	0
Do. alternative estimate	1,644	10	0
Tamplin & Makovski	1,656	0	6
Do. alternative estimate	1,444	5	9
Drake & Gorham	1,543	0	0
Do. alternative estimate	1,209	15	0
National Electric Wiring Company	1,173	8	4
J. O. Grant	1,160	0	0

FORTHCOMING EVENTS.

Monday, April 23rd.—At 8 p.m. Institution of Civil Engineers Meeting. The eighth "James Forrest" lecture on "The Relations between Electricity and Engineering," by Sir W. H. Preece.

Tuesday, April 24th.—At 8 p.m. Institution of Civil Engineers. Meeting.

At 4 p.m.—The Institute of Civil Engineers. Sir William Preece will repeat his lecture. At 8 p.m. Annual General Meeting, to receive the report of the Council, and to elect the Council and Auditors for the ensuing year.

Wednesday, April 25th.—At 8 p.m. Institution of Mechanical Engineers. Dinner.

At 7.30 p.m.—Institution of Electrical Engineers. Students' Meeting. Paper on "Meters and Magnets," by Mr. Humphreys (student).

Thursday, April 26th.—At 8 p.m. Institution of Mechanical Engineers. Meeting.

At 8 p.m.—The Institution of Electrical Engineers. "The Electric Transmission of Power," by Prof. George Forbes, F.R.S. (member).

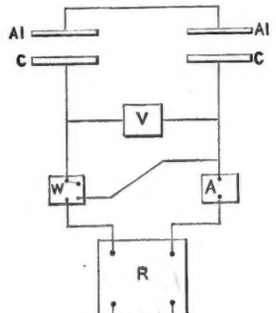
At 3 p.m.—Royal Institution. First lecture on "A Century of Chemistry in the Royal Institution," by Prof. Dewar, F.R.S.

Friday, April 27th.—At 9 p.m. Royal Institution. Lecture by Lord Kelvin on "Nineteenth Century Clouds over the Dynamical Theory of Heat and Light."

At 8 p.m.—Physical Society.

NOTES.

Luminescence of Aluminium Electrodes.—Under this title Mr. W. S. Audrews contributes to the *Electrical World and Engineer* an account of a curious result noticed by him when experimenting with two aluminium carbon cells. He made some further investigations of which the following is a brief *résumé* :—The immersed surface of each side of each plate was 4½ inches × 4 inches, and the cells were charged with a saturated solution of Rochelle salts (double tartrate of potash and soda). The connections of the cells and instruments were as follows :—



Al represent the aluminium plates; C, carbon plates; V, voltmeter; W, wattmeter; A, ammeter; and R a regulating rheostat.

The following readings were taken :—

Volts.		Amperes.		Watts.
90	...	0·25	...	5
110	...	0·25	...	10
120	...	0·30	...	13
130	...	0·35	...	15
140	...	0·40	...	20
150	...	0·50	...	25
155	...	0·70	...	70
160	...	1·40	...	150
165	...	2·00	...	240

At about 90 volts the submerged portion of the aluminium plates became faintly luminous. At about 120 volts a number of little stars appeared on the surface of the plate which increased in brightness, in number and brilliancy as the voltage was raised. At about 150 volts a singing noise was audible, probably due to the rapid formation of bubbles. All these phenomena increased in intensity up to 165 volts, when the liquid became so turbid from the violent evolution of gas that the voltage was not any further increased. The luminescence and stars were not confined to the immersed section, but extended above the surface as far as the salts had crept up the plates. When the cells are newly charged the luminescence appears at a much lower voltage. These cells had been charged 48 hours before the observations here recorded were made.

Lecture.—On 9th inst. Mr. A. L. C. Fell, electrical engineer to the Sheffield Corporation electric tramways, lectured before the Sheffield Society of Engineers and Metallurgists on "The Provision and Distribution of Electric Power for Tramway Traction."

Lightning Fatality.—On Monday last while a football match was in progress at St. Mary Cray a rain and hail storm came on. Among the spectators was a ship's officer, named Davies, who with many others sought shelter in the grand stand. He was there struck by lightning and died after a few seconds. Others were also injured. At the inquest the evidence showed that the flagstaff near the stand was split from top to bottom. Davies's felt hat was partially burned, the crown having entirely disappeared, and the lining was torn out. In the latter there was a clean hole, as though a bullet had passed through it. The right leg of his trousers was torn, and the upper portion of the right boot split and burned. A quantity of money in the right trousers pocket was also fused, and a collar stud well nigh melted. Davies was a tall man, and his head must have been within a few inches of the iron roofing of the stand, along which the lightning apparently ran before it struck him.

Personal.—Mr. C. H. Jowett, foreman turner in the engine department of the Central Marine Engine Works, Hartlepool, has left to take up a position with the Brush Electrical Engineering Company at Loughborough. He received a very hearty send-off last week, and was presented with a handsome silver tea and coffee service and silver-mounted oak tray by the foremen of the works and the workmen. The apprentices presented him with an umbrella and Mrs. Jowett with a gold brooch. Mr. Jowett had been foreman at Hartlepool for nearly 16 years.

Mr. J. M. Blair, from Messrs. Crompton & Co., Limited, has been appointed junior assistant engineer at the electricity works at Hanley.

Mr. S. E. Fedden, electrical engineer to the Greenock Corporation, has been appointed electrical engineer to the Sheffield Corporation electric lighting undertaking, in succession to Mr. Wm. Johnson. There were 23 applicants for the position.

Mr. John MacFee, who entered the service of the National Telephone Company 18 years ago, and has since held several important positions with them, has been appointed acting manager for the Glasgow Corporation Telephones at a salary commencing at £275.

We read in the *Toronto Globe* that Mr. Phelam McCullough, the chief electrician of the Toronto Railway Company, has been appointed electrician in connection with the Liverpool Corporation street tramways at about £1,000 per annum. The *Toronto Globe* appears to have obtained the information before Mr. McCullough, for when interviewed by a representative of the same paper, he said "he had not heard of the incident."

The Naval Engineer.—At the North-East Coast Institution of Engineers and Shipbuilders at Newcastle to-night Mr. W. C. Borrowman will reply to the discussion on his paper on "Some Considerations Affecting the Training of Young Engineers"; the discussion on Mr. D. B. Morison's paper on "The British Naval Engineer" will be resumed; and the President, Sir Benjamin C. Browne, will give notice that he will move, on behalf of the Council, at the closing business meeting to be held in Newcastle-upon-Tyne, on May 18th, 1900, the following resolutions :—

1. That in view of the national importance of an investigation and discussion by engineers of the subject matter of Mr. D. B. Morison's paper, the secretary be instructed to communicate with the various marine engineering institutions throughout the kingdom, enclosing a copy of the paper and discussion, and suggest that each should hold a meeting for the discussion of the subject; that all such discussions should be incorporated in one volume, such volume to form part of the *Transactions* of each institution.

2. That a small committee be formed by each institution, the whole to be embodied in one general committee, which will draw up a report for submission to the Government as representing the opinions and recommendations of the marine engineers of the United Kingdom with reference to the engineering *personnel* in H.M. Navy.

3. That the following gentlemen be elected to form the committee to represent this Institution:—Sir B. C. Browne, Sir Thomas Richardson, M.P., Mr. D. B. Morison, Mr. H. Withy, Mr. T. Westgarth, and Prof. R. L. Weighton.

of an electric tramway and the installation of electric light in that

Humphreys (student).

The Cape-Australia Cable.—The advocates of this cable in the Australian press, in their anxiety to secure the concessions which they hope may have the effect of doing away with the Pacific cable scheme, are not distinguished for lucidity of thought, or ingenuousness of expression. They point out that it may be a year or two before a Pacific cable can be laid, forgetting that the survey for this cable is now completed, and that the route has been found to be quite practicable; whereas, on the other hand, the route for the Cape-Australia cable has still to be examined, and such few indications as exist point to a depth of water quite as great as that in the Pacific, with possibilities of even greater depths being found. Some time must be taken up in making a thorough survey of the Cape-Australia route, and after this is completed the manufacture and laying of the cable will take about as much time as would be the case with the Pacific cable, as the length is about the same in each case; thus it is clear that the argument that the Cape-Australia cable can be completed before that through the Pacific is obviously fallacious.

The American and English Institutions at Paris.—In the *Transactions of the American Institute of Electrical Engineers* for February, we read that in connection with the Paris meeting in August the Institution of Electrical Engineers will offer a dinner in London to the visiting members of the American Institute on August 13th. The members of both bodies will take a special train to Paris on August 15th. The joint meeting will be held at the United States building at the Paris Exhibition on August 16th, and on the evening of the same day a reception will be held at the British building, the headquarters of the British Royal Commission.

Prof. Fleming's Cantor Lectures.—The *Journal of the Society of Arts* announces that the course of Cantor lectures by Prof. James A. Fleming, D.Sc., F.R.S., on "Electric Oscillations and Electric Waves," announced for delivery on May 7th, 14th, and 21st, will of necessity have to be postponed in consequence of the lecturer being unexpectedly summoned to America. The arrangements to be made in consequence of this alteration in the Society's Lecture Programme will be announced later.

Appointments Vacant.—The Brighton Corporation wants a resident electrical engineer to act under Mr. Arthur Wright, the consulting engineer to the electricity works. See "Official Notices" to-day.

A second assistant is wanted for the York electricity works, at £90 per annum. See "Official Notices" to-day.

Société Internationale des Electriciens. — The monthly sitting of the Société des Electriciens was held on April 4th. The greater part of the time was occupied by the election of officers and committee. The results of the elections were as follows:—

President (1901-2).—M. Hillairet.
Vice-Presidents.—MM. Bochet and Leblanc.
Secretaries.—MM. Armagnat and Lorin.
Treasurer.—M. Violet.
Members of the Committee.—MM. Aliamet, Armengaud, Bergès, Berthon, Bouty, Brocq, Canet, Cance, Curie, E. Hospitalier, Léauté, Lequeux, Loppé, Masson, Pollard, Sabouret.

M. Villard read a paper on cathodic and Röntgen rays, and performed experiments showing the properties of these rays. M. Mascart then assumed the office of president for the year 1900.

NEW COMPANIES REGISTERED.

Birmingham Incandescent Lighting Company, Limited (65,637).—This company was registered on April 9th, with a capital of £1,000 in £1 shares, to manufacture, work, buy, sell, let on hire or deal in lamps, brackets, globes, films, mantles, shades, glasses, burners, meters, galvanometers, ammeters, voltmeters, carbons, cut-outs, bypasses, switches, motors, batteries, stoves, turbines, pipes, wires and other gas and electrical accessories and appliances. The first subscribers (each with one share) are:—Rev. J. J. Hind, 42, Francis Road, Edgbaston, Birmingham; T. Nelson, M.D., 1, Reservoir Road, Birmingham; E. D. Kirby, M.D., 106, Hagley Road, Birmingham; J. Wilson, 16, George Road, Edgbaston, chemist; Mrs. L. F. Wilson, 16, George Road, Edgbaston; Miss A. M. Russell, 81, Dolobram Road, Sparkbrook, Birmingham; and A. Wood, Whitehall Chambers, Colmore Row, Birmingham, C.A. John Wilson is the permanent managing director with £150 per annum and 20 per cent. of the net profits. Registered office, 230, Market Place, Dudley.

Ernest Hutton & Co., Limited (65,648).—This company was registered on April 10th, with a capital of £5,000 in £1 shares, to carry on the business of electricians, electrical engineers, and contractors and manufacturers of all kinds of electrical apparatus and appliances. The first subscribers (each with one share) are:—J. E. Hutton, Fowler Gate, Northallerton, electrical engineer; W. Lockwood, Northallerton, solicitor; W. Fowle, Northallerton, solicitor; G. F. Williamson, Warlaby, Northallerton, gentleman; W. G. Jackson, The Mount, Northallerton, schoolmaster; A. H. Curtis, 15, North Villas, Camden Square, London, electrical engineer; and W. G. Hornsey, Market Place, Northallerton, clerk. Table "A" mainly applies.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Eastern Telegraph Company, Limited (6,338c).—This company's annual return was filed on February 22nd, when £5,829,378 stock had been taken up and paid for in full out of a nominal capital of £6,000,000 in £4,000,000 ordinary and £2,000,000 perference stock.

CITY NOTES.

The Indo-European Telegraph Company, Limited.

The directors' report to be presented at the meeting to be held at Winchester House on April 30th, reads as follows:—

Mr. W. S. Andrews has retired from the post of managing director in which he has rendered eminent services for the last 30 years, but remains a member of the board. He has been replaced as managing director by Mr. T. W. Stratford-Andrews. The directors have granted Mr. W. S. Andrews, subject to the confirmation of the general meeting, a retiring pension of £1,200 per annum. Sir W. R. Brooke, K.C.I.E., formerly Director-General of Indian Telegraphs, has accepted a seat at the board since the last general meeting. The shareholders will be glad to be informed that the directors have been successful in obtaining an extension of the Russian and Persian concessions, for a period of 20 years from January, 1905. The company has come to an agreement with the German Telegraph Department, and is now in negotiations with the German Government for a similar extension. The lines of the company continue to work satisfactorily, including the Wheatstone system, which has now been established in the German, Russian, and Persian Sections. In order to strengthen its submarine cable communication through the Straits of Kertch, the company laid a new cable last Autumn; this work was successfully carried out. The company's revenue from all sources for 1899 amounted to £142,343 4s. 2d., as compared with £134,642 12s. 11d. for 1898, showing an increase of £7,700 11s. 3d. The expenses were: on commercial and general account £36,148 8s. 11d.; on maintenance account (expenses and charges) £38,508 18s. 8d.; total, £74,657 7s. 7d., as against £74,346 0s. 5d., for 1898, an increase of £311 7s. 2d. Deducting the above expenses, £74,657 7s. 7d., from the total revenue, £142,343 4s. 2d., a balance remains of £67,685 16s. 7d., from which income-tax paid, £2,195 4s. 8d., has been deducted. To this amount brought from the year 1893, £9,702 0s. 9d., has been added, and there remains the sum of £75,192 12s. 8d. From this amount £25,000 has been placed to reserve, and that sum, together with £10,625, amount of intrim dividend, has to be deducted, leaving a balance of £39,567 12s. 8d. The directors now propose the declaration of a dividend for the six months ending December 31st of 17s. 6d. per share, making, with the dividend already paid, 6 per cent., and a bonus of 20s. per share, both free of income-tax, making in all 10 per cent. for the year, carrying forward £7,692 12s. 8d. to the credit of 1900. The following directors retire, and offer themselves for re-election:—W. S. Andrews, Esq., and John Von Berenberg Gossler, Esq. In case any shareholder should be unable to attend the general meeting, he is requested to fill up and return the enclosed proxy form, duly signed, so as to reach the company's office not later than 12.30 p.m. on the 28th inst. Holders of shares to bearer must deposit their

shares, with name and address, at the office of the company, 48 hours before the time appointed for the meeting, against an order of admission. The share warrants will be returned after the meeting. The transfer books will be closed from the 16th to the 30th inst., both inclusive. The auditors, Messrs. C. F. Kemp, Sons & Co., chartered accountants, retire, and offer themselves for re-election.

Thames Ironworks and Shipbuilding Company.

At the first annual meeting of this company, held at the Memorial Hall, Farringdon Street, the chairman, Mr. Arnold F. Hills, in moving the adoption of the report, referred in some detail to the great amount of first-class Admiralty work they had in hand, as well as similar construction work for foreign governments. As far as the engineering department was concerned, last year was mainly one of "change and shift." The machinery had to be moved from the shops in Blackwall to those at Greenwich and Deptford, which had had to be equipped with modern machinery. The engineering contracts in hand were at an early stage, and therefore he preferred not to say much about them. He then gave particulars of the progress which was being made in connection with the civil engineering and electrical engineering departments of the company, and said that, owing to money being required to finance work now being carried out, it was proposed to raise further capital by the issue of additional preference shares. He moved the adoption of the report and the payment of a dividend at the rate of 5 per cent. per annum on the preference shares, less income-tax, to December 31st last.

Mr. A. A. Knight seconded the motion, which was carried. An informal resolution was afterwards carried to the effect that, in view of the magnitude of the company's existing contracts and the constantly increasing business, the recommendation of the board for increasing the capital by an issue of £100,000 6 per cent. cumulative preference shares should be approved, and be referred for sanction to a special meeting.

The British Columbia Electric Railway Company, Limited.

A general meeting of this company was held at Cannon Street Hotel on Wednesday, Mr. Horne-Payne presiding. The following resolutions were passed:—

1. That the capital of the company be increased from £870,000 to £450,000 by the creation of 8,000 new preference shares of the nominal value of £10 each in addition to the 12,000 preference shares of the like nominal value already issued, such new preference shares to rank *pari passu* with, and to entitle the holders thereof to the same rights and privileges as the holders of the said 12,000 existing preference shares, that is to say:—

(*a*) The said new preference shares to be 5 per cent. non-cumulative shares, but preferential both as to repayment of capital and payment of dividend.

(*b*) The said new preference shares to be issued on the terms that the profits of the company declared by the directors in each year to be available for dividends shall be applied (1) in paying a non-cumulative dividend not exceeding 5 per cent. to the holders of all the preference shares in the company in proportion to their respective holdings; (2) in paying a dividend not exceeding 7 per cent. to the holders of the ordinary shares in proportion to their respective holdings; and (3) in distributing the residue (if any) of such profits amongst all the shareholders of the company in proportion to the shares, of whatsoever kind, held by them respectively.

2. That the directors be, and they are hereby, authorised to allot the said new preference shares to such persons and at such times and upon such terms (not being inconsistent with the foregoing terms) as they may think fit.

A circular which had been sent out to shareholders stated that, owing to the great success of the company, and to the rapid extension of its business, both in the railway and lighting departments, the directors contemplated, at an early date, the further enlargement of their plant by the addition of an electrical unit both in Vancouver and in Victoria, and by the purchase of a considerable amount of additional rolling stock. The increase in the company's business has been very profitable. During the past 11 months the gross receipts have been largely in excess of those of the corresponding 11 months of the previous year, as the following figures show:—

Gross Receipts for Eleven Months, April to February.

	Railway Department.			Lighting Department.		
	Vancouver Division.	Westminster Division.	Victoria Division.	Vancouver Division.	Victoria Division.	Total.
1898-1899 ..	$69,163	$78,478	$78,585	$96,517	$54,917	$377,605
1899-1900 ..	87,923	82,641	83,098	105,092	57,764	416,448
Increase ..	$18,760	$4,163	$4,558	$8,505	$2,847	$38,838

The increase in the lighting department, as measured by the number of lights supplied, is as follows:—

Lights Supplied.

	Arcs.	32 c.p.	24 c.p.	16 c.p.	10 c.p.	4 c.p.	Total.
April 1st, 1899 ..	347	951	367	15,908	10,275	4,747	32,640
March 1st, 1900 ..	400	1,050	428	20,863	14,579	7,797	45,112
Increase	53	99	61	4,955	4,304	3,050	12,472

There is every indication of the demand for light further increasing very largely in the coming winter, as well as of the railway business increasing, and in order that the company may take advantage of this, additions must be made to the lighting plant and rolling stock, and it is proposed to raise funds for these purposes in the manner mentioned in the resolution given above. Only a small portion of this additional share capital is required at present, as the amount required during the next two years will probably not exceed from £20,000 to £25,000, and it is proposed to raise capital only as it is required.

Before moving the resolutions, the chairman made a few remarks regarding the position of the company. He said that it was not a popular thing to ask shareholders to increase the capital of a company, but on this occasion it was not brought about by losses or difficulties, but by their prosperity. They were not in full possession of the figures for the financial year, but the gross earnings would amount to about £40,000, as compared with £33,000 for the previous year. They would save the expense of a public issue as their own shareholders would be only too glad to take up the new capital. The works undertaken with the proceeds of the last issue of preference shares were considerably delayed by the great activity in the iron and steel trade. The work should have been completed by September, 1898, but in fact one of the most important portions—the steam plant at Vancouver City—was only completed about a month ago. The works contemplated by the 1898 prospectus are now completed and operating satisfactorily. The cost had been in excess of what was expected owing to the rise in the price of steel, iron, and copper, but some operations had cost less than anticipated, so that on the whole the excess would not be very large. The present plant is equal to the business of the summer months, but the demand was on the increase at the rate of 1,000 lights per month, and they must look forward and have increased plant by the coming winter months. Ample provision had been made for steam or water-power, and there was ample room for accommodating more and larger plant; what they now required was really the electric lighting machinery. A little electrical plant was wanted for the railway, but that was comparatively unimportant. The expenditure required to cover the coming winter was about £16,000, but they were asking powers to increase the capital from time to time as need might arise. They were only increasing the plant for the sake of taking more business and making larger profits. They would be only too pleased when the opportunity arose to issue the whole £80,000. The shares would be offered to shareholders on a *pro rata* allotment.

The resolutions were carried.

The Oriental Telephone and Electric Company, Limited.

The directors' report for the year ending December 31st, 1899, presented at the ordinary general meeting at Cannon Street Hotel on Wednesday, April 25th, at one o'clock p.m., reads as follows:—

The directors herewith submit to the shareholders a statement of the accounts of the company for the past year. The revenue account shows a balance to credit of £11,738 12s. 10d. transferred to profit and loss. Including £1,344 8s. brought forward from 1898, and after deduction of £2,859 8s. paid as interim dividend on October 31st, there remains £10,224 12s. 10d. for disposal. The directors recommend dealing with this sum as follows:—To pay a final dividend of 8d. per share, free of income-tax, making 5 per cent. for the year, to transfer to reserve £8,000, and to carry forward £1,507 16s. 10d. The electric lighting branch of the company's business shows a small but increased surplus over that obtained in 1898, which the directors propose to carry to the suspense account opened last year. The dividends declared by the Indian subsidiary companies have, as usual, been included in the revenue account, and the amounts have been duly remitted to us. Both these companies have paid 6 per cent. for the year, and have carried forward substantial sums to provide funds for future contingencies. The Telephone Company of Egypt has declared a 6 per cent. dividend as usual on its preferred shares, and has also been able to transfer a considerable amount to reserve for further developing the business. The China and Japan Telephone Company has paid its debenture interest, but the accounts for the past year have not yet been closed. The exchange at Hong Kong is making highly satisfactory progress, and a branch exchange will probably be opened in the course of this year at Kowloon, the British possession on the mainland opposite Hong Kong, which has recently been greatly extended. The directors of that company, on the other hand, regret that they have not been able to secure the concession at Shanghai, for which they had tendered. No other tenders were received by the Municipal Council, yet although all conditions were accepted, the Council decided upon imposing further conditions, including the right of withdrawing the concession under circumstances which it would have been easy to bring about. In the interest of the company such a condition could not, therefore, be accepted. The right to work the telephone in Shanghai was thereupon, and without allowing even a reasonable interval for counter-proposals, given to local persons of influence with the Council, who had in the meantime come forward. It appeared, however, afterwards, that none of the onerous conditions were required of them which had been demanded of the China Company. The exchange at Shanghai was consequently closed on the 31st ult., and the town will, for some considerable time to come, be without a telephone service. Under Article 65, the directors to retire at the present meeting are Messrs. W. Addison and T. Lloyd, who being eligible, offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and offer themselves for re-election.

Babcock & Wilcox, Limited.

The meeting of this company was held at 147, Queen Victoria Street, E.C., on 10th inst., Mr. John Dewrance presiding.

In moving the adoption of the report, the Chairman remarked that the business had been largely increased, but so had also outstanding accounts and working expenses and the stocks. The profit, after deducting the amount written off "purchase of business account," amounted to £106,585, which with the balance brought forward made £115,918. After deducting the interim dividends for the half-year to June 30th last, at the rate of 6 per cent. per annum on the preference shares and 20s. per share on the ordinary shares, there was a balance of £90,918, from which they recommended a 6 per cent. dividend on the preference shares and a dividend of 20s. per share on the ordinary shares for the half-year to December 31st last. They proposed to place £50,000 to the reserve fund, which would leave a balance to be carried forward of £15,918.

Sir William Arrol, M.P., seconded the resolution, which was adopted.

An extraordinary general meeting was afterwards held to consider resolutions for winding up the company voluntarily, its reconstruc-

tion, and the appointment of Messrs. J. H. Rosenthal and A. T. Simpson as liquidators.

The Chairman explained that the reason for bringing forward the reconstruction scheme was the enormous expansion of the business. Although they had made such very large profits, they were actually short of money, or would become so in the immediate future, the increasing business requiring a very large capital. It was necessary the board should make due provision for the future. The works, which had been extended by the increase in the plant throughout the year, were still fully occupied, and it was desirable that they should be further largely extended. The 90,000 ordinary shares in the new company were to be offered for subscription to both classes of shareholders at a premium of 50 per cent., or £1 10s. per share. The chairman proposed resolutions for carrying out the agreement, and these were unanimously adopted.

An extraordinary general meeting will be held on the 27th inst., when the resolutions for reconstruction passed at the extraordinary general meeting held on the 10th will be submitted for confirmation.

Willans & Robinson, Limited.

The ordinary general meeting of the shareholders of the above company was held at the Cannon Street Hotel on Wednesday last week, Mr. M. Robinson (chairman) presiding.

In moving the adoption of the report, the Chairman said he did not think that he need say very much about them. It would scarcely be questioned that the half-year's results were satisfactory, and they hoped there would be no disposition to challenge the increased distribution which they proposed to base upon them. They had always desired, before taking any step in advance, to make reasonably sure that there should be no going back afterwards, and they had felt their way only by gradual steps to the 10 per cent. return which they had enjoyed for some time past. They did not think that the present prosperity had endured quite long enough to justify them in paying a 12 per cent. *dividend*, they preferred to call the addition a "bonus," which was meant to suggest something perhaps a little less assured than the dividend they were accustomed to. It was true, the flood tide of their prosperity showed no sign of ceasing, or of flowing less strongly, and they might yet see 12 per cent. stereotyped in their account forms. The difficulty of getting their new capital into profitable work was a very real one, and they might congratulate themselves that the instalments on the last issue had been spread over so long a period. The delays by the contractors for the extensions of the works at Rugby have been bad enough, but at Queen's Ferry, the site of the new boiler works, they had been most unfortunate. Months were occupied in coming to agreement, not only with the landlords, but with other interests concerned, such as the Conservators of the River Dee, in whose tideway their pier must be built. At last everything was signed and ready to be exchanged, when suddenly one of the judges was found to have given a judgment respecting certain leasehold property, in no way concerning them, which, they were informed, incidentally invalidated their lease, and with it a large proportion of all the leases in England! The parties concerned had not appealed, so the judgment stood for the present, and their lease had now to be submitted to the Court for special approval. It was said that that would be soon obtained, but if not, and they should be threatened with the delays of an appeal, they might have to give up Queen's Ferry entirely. In fact, other sites had been examined, and they hoped no great delay need be anticipated if the change be forced upon them. The more important and heavier articles of machinery, already on order, could scarcely be ready before the buildings, even if the latter had to be erected upon one of the new sites, while the drawings and specifications for the buildings would be applicable to another site with little change. Nothwithstanding those delays, it would be wise to issue the remaining shares before long, though the board proposed to spread the payment over as long a time as was reasonable—say a year. The price of issue would have their careful consideration; and, broadly speaking, the directors held to the view, expressed on previous occasions, that it was not wise to fix the price at the very highest obtainable; it was better to issue at a moderate price, and to let the profit be divided between the company as a body, in the form of premiums, and the shareholders as individuals in the form of added value to their holdings or of profit upon resale. The shareholders would doubtless be interested to hear that the Admiralty trials of the Niclausse boiler in H.M.S. *Seagull* had at length been brought to an end—three years after the boilers were made and delivered to the Admiralty. Compared with the boilers which were to be made at Queen's Ferry, those of the *Seagull* might almost be described as of obsolete pattern, and that largely took from the comparative interest and value of the economical results obtained. The Admiralty figures on this subject, whatever they were, were not published, but it was no secret that the Niclausse boiler, in respect of practical convenience and reliability, passed its tests with flying colours. A number of trials were made, each consisting, or intended to consist, of 1,000 miles under steam, in all sorts of weather and sea. Before leaving the subject of the Niclausse boiler, and the boiler works, it should be said that the much increased scale upon which they now contemplated the manufacture must lead in the future to still larger necessities in the way of capital, beyond the 20,000 shares to be issued this year. They had satisfied themselves that at Chester they must be more than boilermakers, and that they should be prepared to make much of the other material for themselves. Turning to the accounts, they would see that they continued to add largely to the reserve fund out of the ordinary profit, viz, at the rate of £7,000 per annum, besides £4,000 per annum carried to the debenture sinking fund. Taking into account the premium upon the forthcoming issue of shares, there could be little doubt that they ought soon to see a reserve fund equal to their whole debenture debt, apart from the separate provision which was being made for the redemption of the debentures. In the profit and loss account they would see a new item of expenses, £63 8s., for reservists' families and for the works war fund. Last year, before the war broke out, their men raised the question of a works' volunteer force, and the directors afforded every facility for that purpose. They had also offered, if the War Office would come forward a little more liberally than it did at present in helping in the first equipment of the corps—he meant as regards the cost of uniforms and the like—that they would present the corps with a machine gun with suitable carriage equipment. 144 men had put down their names, besides 17 boys, who aspired to be buglers, so if funds were forthcoming, they could even start two companies. The company was sending a large engine to the Paris Exhibition, coupled to a dynamo made by Messrs. Siemens Bros. & Co. The authorities had given it an admirable position in the British section, where it could not fail to attract attention.

Mr. Marriott seconded the motion.

Answering several questions, the Chairman said the further issue of capital was to make the Niclausse boiler, which they considered would be a profitable undertaking. They could not carry out great things without a fair amount of capital. They believed there would be a large demand for the new boiler.

The report was adopted.

Eastern Extension, Australasia, and China Telegraph Company, Limited.

The report for the half-year ended December 31st states that the gross receipts amounted £339,450, against £290,431 for the corresponding half-year of 1898. The working expenses, including £39,057 for maintenance of cables, absorb £116,935, against £100,085 for the corresponding period of 1898, leaving a balance of £222,515. From this is deducted income-tax, interest on debentures, debenture stock, and contribution to sinking fund, £5,000 for reserve fund in connection with the proposed removal of head offices, and £500 towards the Transvaal War Fund, leaving as the net profit for the half-year £185,783, and, after adding £13,299 brought forward, there is an available balance of £199,082. One quarterly interim dividend of 1½ per cent. has been paid, and it is now proposed to distribute another of like amount on the 26th inst., making with the interim dividends paid for the first half-year a total dividend of 5 per cent. It is also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year 1899. The balance of £86,582 has been transferred to the general reserve fund. The agreement with the Australasian Colonies for the payment of subsidy in respect of the Australian duplicate cable expired by effluxion of time on October 31st last; and, in terms of the trust deed, the balance of the company's 5 per cent. Australian Government subsidy debentures, amounting to £33,300 will be paid off at par on July 2nd next. The tariff guarantee agreements with the Australasian colonies expire on the 30th inst. An agreement has been concluded with the Governments of South Australia, Western Australia, and Tasmania, for the establishment by this company, in conjunction with the Eastern Telegraph Company, of direct cable communication between South Africa, Perth, and Adelaide; which, with the third route recently opened between Great Britain and the Cape, will provide Australia with an alternating line to the existing service. The arrangement also provides for an immediate reduction of the tariffs between Great Britain and the contracting colonies to 4s. per word, with proportionate reductions for Government and Press telegrams; and, as the traffic responds, for the further lowering of the tariffs on a "standard revenue" basis down to 2s. 6d. per word. The tariff between the contracting colonies and South Africa will also be reduced from 7s. 1d. per word to about 2s. 6d. per word on the opening for traffic of the new cable. In return for these concessions the company is to exercise the right of direct dealing with the public in the capitals of the contracting colonies when the proposed Government Pacific, or other competing cable, is laid.

Great Northern Telegraph Company, Limited (of Copenhagen).

The accounts of this company for the year 1899, show that the tariff receipts had amounted to £433,573 less £20,698 loss on exchange = £412,875. Adding to this £61,417 brought forward, and a sum for interest and sundries, there is a total on the credit side of revenue account of £486,523. On the other side, salaries and wages appear at £53,294 17s.; expenses at stations, offices, and agencies, £6,953; ordinary supervision and maintenance of sea and land lines and repairing steamers *H. C. Orsted* and *Store Nordiske*, £11,714; and sundry other items bringing up the total expenses to £87,009. Interim dividends already paid amount to £75,000, and the final dividend proposed (15s. per £10 share) is accountable for £112,500; reserve and renewal fund dispose of £138,888; staff pension fund, £5,555; debenture interest, £1,750; directors' remuneration, £1,500; and there is a balance carried forward to 1900 of £64,319. In the balance-sheet the capital expenditure upon cables and landlines in Europe, China, and Japan, including all appurtenances, according to balance-sheet December 31st, 1898, is set down as £2,055,555, less £171,864 written off = £1,151,133. Investments on account of reserve and renewal fund are £1,151,133; cash, £69,343, and sundry debtors, £69,449.

from £20,000 to £25,000, and it is proposed to raise capital only as it is required.

An extraordinary general meeting was afterwards held to consider resolutions for winding up the company voluntarily, its reconstruc-

Anglo-Argentine Tramways Company, Limited.

At a meeting of this company held at Cannon Street Hotel last week, after referring to the general business of the company, the accounts, and so forth, the chairman, Mr. H. Doughty Browne, said that under the arrangement made by the company with the Argentina Electric Traction Company, the latter guaranteed the ordinary share capital of this company a *minimum* dividend at the rate of 4 per cent. during a period not exceeding 5 years, but if the profits on the undertaking exceeded this 4 per cent., that amount was capable of being divided among the shareholders. Guaranteeing a *minimum* of 4 per cent, the Traction Company must know that they had not to make up something in future years before the surplus was divided; and the result would, he trusted, be that at the end of five years—or a shorter time if the conversion to electricity took place earlier—there would be a very considerable surplus for division among the shareholders. He congratulated them on the fact that the negotiations for an electrical concession had been brought to a conclusion satisfactory to the company and to the municipality of Buenos Ayres. The new concession was for 99 years, and in many ways it was favourable to the company. Under the agreement first made by them with the Traction Company the latter were to allow a certain portion of this company's rails to remain in the road, as they might be fairly utilised for electric traction; but further investigation had shown that it would be neither wise nor economical to retain any of the existing rails for the purpose of carrying on the business when the line was converted. As this would involve a considerable expense (about £90,000, against which, however, there would be the amount realised for the old rails) the directors had agreed that the amount of unissued debenture stock—about £36,000—should be raised.

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to—British Electric Traction Company, Limited—Further issue of £150,000 5 per cent. perpetual debenture stock. The Stock Exchange Committee have ordered the undermentioned securities to be quoted in the Official List:—Edmundson's Electricity Corporation, Limited—£75,000 4½ per cent. first mortgage debenture stock.

Application has been made to the committee to appoint a special settling day in and to grant a quotation to City of London Electric Lighting Company—further issue of 20,000 ordinary shares of £10 each fully paid, Nos. 100,001 to 120,000.

Dudley, Stourbridge and District Electric Traction Company, Limited.—The directors' report, which arrives too late for publication at length in to-day's issue, shows the total revenue for the year 1899 as £11,504, and the total expenditure as £7,195. There is thus a net profit of £4,309 plus £919 brought forward = £5,228. After paying 5 per cent. on the preference shares, 3 per cent. is declared on the ordinary capital; £1,000 is placed to depreciation and £2,313 carried forward. Additional preference and ordinary capital is to be issued.

Meetings.—Yesterday meetings of the Automatic Telephone Company and the Buenos Ayres Electric Tramways Company were held in London. Our report of the proceedings will appear next week.

The General Electrolytic Patent Company, Limited, Widnes.—This company has just declared a dividend for the past year of 200 per cent.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending April 14th, 1900, were £488 7s. 10d.; receipts for corresponding period, 1899, £222 17s. 1d.; aggregate for half-year to date, £2,767 6s. 3d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending April 18th, 1900, were £3,038 16s. 4d.; corresponding period, 1899, £2,542 17s. 4d.; increase, £490 19s. 0d.

The City and South London Railway Company.—The receipts for the week ending April 15th, 1900, were £1,159; ditto April 16th, 1899, £1,051; increase, £108. Total receipts for half-year, 1900, to date, £18,477; corresponding period, 1899, £16,265; increase £2,212. Miles open April 15th, 1900, 3¾; April 16th, 1899, 3¾.

The Dover Corporation Tramways.—The receipts for the week ending April 14th, 1900, were £210 13s. 4d.; April 15th, 1899, £151 6s. 6d.; increase, £59 6s. 10d. Total receipts to date, 1900, £2,239 19s. 0d.; corresponding period, 1899, £2,261 6s. 2d.; decrease, £21 13s. 3d. Miles of track open, 1900, 8; 1899, 8. Car miles run, 1900, 5,073; 1899, 4,245. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, April 13th, 1900, were as follows:—D. U. T. Co., horse cars, £60 16s. 1d.; ditto, electric cars, £3,934 3s. 6d.; D. S. D. Co., electric cars, £1,167 11s. 2d.; total, £5,162 10s. 9d.; corresponding week last year—D. U. T. Co., horse cars, £1,723 18s. 1d.; ditto, electric cars, £940 17s. 7d.; D. S. D. Co., electric cars, £645 7s. 3d.; total. £3,320 2s. 11d.; increase, £1,842 7s. 10d. Aggregate to date, £56,872 19s. 0d.; aggregate to date last year, £48,846 7s. 8d.; increase to date, £7,526 11s. 9d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending April 15th, 1900, amounted to £1,851: corresponding week last year, £1,404; decrease, £53. Total increase in traffics for half-year to date, £702.

The South Staffordshire Tramways Company.—The receipts for the week ending April 13th, 1900, were £670 17s. 1d.; April 14th, 1899, £614 8s. 7d. Aggregate receipts for 15 weeks, £9,176 0s. 11d.; last year, £8,208 4s. 2d.

STOCKS AND SHARES.

Wednesday Evening.

Eagerly anticipated as "After Easter" had been by the Stock Exchange, the result up to the present has proved distinctly disappointing. So far there is but little increase in the volume of general business. It is a good sign, however, to note the number of bargains that are recorded day by day in electrical supply descriptions. Telegraph securities are quiet, and there is not much doing in tramway and traction shares, so that the supply department may consider itself peculiarly fortunate in attracting what business it has done this week.

Westminsters now constitute the most active market. The uncertainty as to whether the new shares will be issued at par (£5) or at £10 has given rise to quite a lot of speculation in the existing shares. As we reported last week, the chairman of the company, Lord Suffield, moved a resolution at the meeting for the creation of 30,100 new Ordinary shares at £10, but an amendment proposing that they should be issued at £5 was carried by 27 votes to 19. After that, a poll was demanded and fixed for May 11th. We are unable to see what reason there can be for postponing the poll until that time. The company wants the money, and the shareholders will be thankful to have the matter settled as soon as possible. Why, then, this month's delay? To us there seems to be neither rhyme nor reason in it.

The fact that the Metropolitan Electric is, after all, to have a competitor in Marylebone has not affected the price of the shares, which remain hard at 14. London Electrics have not regained their fall of last week. Charing Cross are being heavily dealt in, but show no quotable change. In fact, the whole list of 26 securities is, nominally, just where it was when we wrote eight days ago.

The characteristically April weather prevailing during the Easter holidays prevented the railway companies from enjoying as much benefit as it was hoped that they would do from the excursionist traffic. The figures are not bad by any means, but the bumper receipts which had been anticipated failed to show themselves. Metropolitan District Ordinary is even down a fraction on the week, and now stands at 30⅜, electric traction notwithstanding, and Metropolitan Consolidated stock is no better than 106. City and South London is again being supported by its usual friends. The market talks about the coming cricket season at the Oval as being likely to enhance the company's traffic. Central Londons are marking time, while Waterloo and City seem quite content to remain in the groove into which they fell a month or two back.

Once more the ridiculous lack of uniformity that exists in the Stock Exchange with reference to marking stocks and shares *ex* dividend is exemplified in the case of the Submarine Cables Trust Company, whose stock was marked *ex* on April 17th in the middle of a settlement. The confusion and consequent irritation which is engendered between client and broker are quite sufficient under ordinary circumstances, but are greatly increased by the senseless deduction of the dividend between one account day and another.

Anglo-American Ordinary and Preferred were both *ex* last Wednesday, and the former show a drop of 1¼ per cent., after allowing for the dividend, although the Preferred stock is unchanged. It is amusing to hear some estimating the possible distribution on the Deferred stock, the announcement of which will not be made for another eight months! This stock—"Anglo A," as the Stock Exchange calls it for brevity's sake—is unchanged. Eastern Telegraph stocks are also quoted minus the dividend, and after allowing for this, there is virtually no change worth mentioning in the prices. Globe Telegraph Preference are being bought, but Western Telegraph Debentures show a loss of a point.

Telegraph Manufacturing Ordinary and Preference are both better, the former having gained 10s. and the latter 5s. per share. We have consistently pointed out the advantages which are likely to accrue to this class of investment by reason of the increased demand for cables and kindred manufactures all the world over. Callender's Preference have been wanted at 5⅛, but the Ordinary do not vary. Babcock and Wilcox are up again this week, their present price of 53½ *ex* dividend leaving them £2 to the good.

Righteous indignation is being expressed by shareholders in the London Tramways Company at the prospect of their only receiving £9 10s. per share from the liquidator when at least £10 was reasonably expected. The matter certainly seems incomprehensible, but perhaps some light will be thrown upon the subject at the meeting. Tramway and traction shares are being neglected in the market this week.

accounts, they would see that they continued to add largely to the reserve fund out of the ordinary profit, viz, at the rate of £7,000 per

on account of reserve and renewal fund are £1,151,153; cash, £69,343; and sundry debtors, £69,449.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, April 10th.	Closing Quotation, April 18th.	Business done during week ended April 18th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	65 — 68	63 — 66 xd	64½	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	116½—117½	115 —116	116	115¾
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	14½— 15	14½— 15	14 13/16	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	...	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,332,823£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	..	...	102 —104	102 —104	103¾	103½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½%	1 %	...	½— ¾	½— ¾	...	...
16,000	Cuba Telegraph	10	7 %	8 %	...	9 — 10	9 — 10	10	9⅝
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	...	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101—105%	101 —105%	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	11½— 12	11¾— 12¼	12⅛	11
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	152 —157	151 —156 xd	154	152
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —101	98 —101	9⅞	9⅝
1,482,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	..	115 —120	115 —120	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16 — 16½	16 — 16½	16½	16 5/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	100 —103	100 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	115 —120	115 —120	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	...	11½— 12	11¼— 12	11⅜	11 3/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15½— 16	15½— 16	15⅞	1 ⅛
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	...	...	33 — 35	33 — 35	...	...
86,800	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	54 — 58	54 — 58	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	...	...
72,630	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,630 ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	5 — 5½	5 — 5½	5 1/16	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5¾	5½— 5¾	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	97 —100	97½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	102 —105	102 —105	...	...
11,339	Reuter's	8	5 %	...	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	126 —131	124 —129 xd	...	...
58,000	United River Plate Telephone	5	5 %	6 %	6 %	4¾— 5¼	4¾— 5¼	...	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4¾— 5¼	4¾— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	97 —100	97 —100	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	.
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	100 —104	100 —104	...	..
205,993	Western Telegraph, Ltd., Nos. 1—205,993	10	...	...	...	14½— 15	14½— 15	14⅞	14¾
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	106 —109	105 —108	...	...
88,321	West India and Panama Telegraph	10	⅝%	...	...	¾— 1⅛	¾— 1⅛	1⅛	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	9½— 9¾	9½— 9¾	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	7 — 8	7 — 8	...	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	104 —107	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	...	...	8½—9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	6 %	6 %	6 %	6½— 7½	6½— 7½	...	..
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	...	...	108 —111	108 —111	110	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	10 %	6 %	4 %	10 — 11	10 — 11	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	4 %	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12½— 13½	12½— 13½	13⅜	13½
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	109 —112	109 — 112	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4¾— 5¼	4¾— 5¼	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 2	1½— 2	...	...
48,050	Do. do. do. 6 % Pref.	5	...	6 %	...	4½— 4¾	4½— 4¾	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½— 14½	13½— 14½	14	3¾
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	114 —117	114 —117	...	...
125,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15 3/16	...
30,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2¼— 2⅝	2¼— 2⅝	...	...
5,000	Do. Do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4 — 4½	4 — 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	12 %	12 %	13 %	15 — 16	15 — 16	15 9/16	15½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation April 10th	Closing Quotation April 18th.	Business done week ended April 18th, 1900. Highest.	Lowest
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	...	...	2⅜— 3½	2⅜— 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
30,000	British Electric Traction	10	...	6 %	...	17 — 18	17 — 18	17⅝	17½
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	12⅜— 13½	12⅜— 13½	13⅛	...
200,000	Do. do. 5 % Perpetual Debenture Stock	Stock	...	...	...	124 —127	124 —127	...	...
45,000£	†British Electric Works Co., Ord. £1 shares, 50,001—95,000	...	...	...	...	⅞— 1	⅞— 1	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000	...	...	...	...	⅞— 1	⅞— 1	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	99 —101	99 —101	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500	5	...	...	...	6 — 6¼	6 — 6¼	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	3 %	5 %	...	1⅞— 2	1⅞— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	2 3/16	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	108 —113	108 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000	5	12½%	15 %	...	14½— 15½	14½— 15½	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5 13/16	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —116	112 —116	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅝	10¼— 10⅝	10½	10⅜
61,088	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5 1/16	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	...	...
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	67 — 70	67 — 70	68½	67½
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	10	...	...	...	6 — 7	6 — 7	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	...	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red.	100	...	...	...	93 — 95	93 — 95	94¼	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000	2	7 %	7 %	...	2⅜— 3½	2⅜— 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ¾	⅝— ¾	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	...	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13½— 14½	13½— 14½	13⅞	...
12,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5⅜	5½— 5⅜	5⅜	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½ %	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works	10	10 %	10 %	...	21 — 22	21 — 22	...	...
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3⅜%	8⅜ — 8⅞	8⅜ — 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	12⅞— 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	36 — 40	37½	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909	100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	...	...	9½— 10½	10 — 11	...	...
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000	5	...	...	...	5½— 5¾	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 105—108.
National Electric Free Wiring, 12/6 paid. 9—11.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17—18.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, 2—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 7—7⅛. Debentures, 105—108. Dividend, 1899, on Ordinary Shares 11 %.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6¼.
*T. Parker, £10 (fully paid), 18.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (January 25th, 1900).

MARKET QUOTATIONS, Wednesday, April 18th.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	22/-	..
a ,, Oxalic .. .. .. per cwt.	32/-	32/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£34	£34	..
a ,, ,, ... per ton	£31	£31	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 10	£26 10	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a ,, White Sugar .. .. per ton	£31	£31	..
a ,, Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	4½d.	4½d.	..
a ,, Caustic (76/60 %) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a ,, Crystals .. .. .. per ton	£3	£3	..
a ,, Bichromate, casks .. per lb.	3½d.	3½d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b ,, Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£80 to £150	£80 to £150	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c ,, Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c ,, ,, (solid drawn) .. per lb.	9d.	9d.	..
c ,, Wire, basis .. .. per lb.	8½d.	8½d.	..
c Copper Tubes (brazed) .. .. per lb.	11½d.	11½d.	..
c ,, ,, (solid drawn) .. per lb.	11½d.	11½d.	..
g Copper Bars (best selected) .. per ton	£88 to £89	£87 10 to £89	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£89 to £90	£87½ to £89	inc.
g ,, Rod .. .. .. per ton	£88 to £90	£87½ to £89	inc.
c ,, (Electrolytic), Bars .. per ton	£85	£85	..
c ,, ,, Sheets .. per ton	£94	£94	..
c ,, ,, Rod .. per ton	£88	£88	..
c ,, ,, H. C. wire per lb.	10d.	10d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
a German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	8/- to 8/6	8/-	inc.
h India-rubber, Para fine .. .. per lb.	4/2	4/2½	½d. dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) per ton	78/9	77/6	1/3 inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 2 6	£16 15	7/6 inc.
g ,, ,, Sheet .. .. per ton	£18	£18	..
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£9 12 6	£9 12 6	..
d Mica (in original cases), small per lb.	8d. to 9d.	8d. to 9d.	..
d ,, ,, ,, medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, r'l'd str'p & sheet per lb.	From 1/3	From 1/3	..
o Platinum .. .. per oz.	£3 12	£3 12	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£143 10s. to £144 nom.	£140 to £141	inc.
g ,, foil .. .. per lb.	1/9	1/9	..
n ,, wire Nos. 1 to 16 .. .. per lb.	1/9	1/9	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lea. .. per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. .. per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove .. per ton	£15	£15	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27 5 nett.	£27 5 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Messrs. Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Belling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. F. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

N. R. K. writes:—The occurrence of a heavy fall of snow has recently caused a large amount of breakage among the telephone wires in this town. The electric trams are here worked by the trolley system, the cable being usually protected from falling telephone wires by guard wires or insulating material. After a recent snowstorm the fall of a telephone wire short-circuited the trolley wire, with the result that a horse was killed in the street by electric shock. I shall be glad to know (1) who, if anyone, is liable for the accident; (2) whether, assuming that the Electricity Supply Company might sometimes be liable for the consequences of such accidents, the adoption of such a precaution as insulation, absolves them from liability?

*** Assuming that the supply company in which our correspondent appears to be interested, carry out their undertaking in accordance with a provisional order, embodying provisions similar to those contained in the Electric Lighting Act, 1899, it is clear that they are answerable for all accidents, damages, and injuries happening *through the act or default of their servants* [Sec. 77]. Apart from this, and as upon the above facts, there is no evidence of negligence, they do not appear to us to be bound to take extraordinary precautions on behalf of everyone whose property may be injured by the electric current passing through the wire. It would seem that the liability (if any) lies with the telephone company, inasmuch, as they committed a trespass by allowing their wire to fall upon the trolley wire. We recall a case from South Staffordshire (in 1898), in which, upon a very similar state of facts, the telephone company were fixed with liability—the principle of law being, of course, that in all actions for tort, the liability rests with the person who had the last chance of avoiding the accident. We are not told who are the proprietors of the telephone wire, and are therefore unable to say whether they would be excused (as they very well might be), on the ground that the accident was caused by *force majeure*.

In answer to the second question, we think it is clear that the taking of precautions similar to those mentioned by our correspondent would in all probability completely absolve the supply company.

NOTE ON THE VARIATION, WITH TENSION, OF THE ELASTIC PROPERTIES OF VULCANISED INDIA-RUBBER.*

By Prof. J. G. MACGREGOR and Mr. W. A. MACDONALD, Dalhousie College, Halifax, N.S.

This paper is an account of some experiments made in Prof. Macgregor's laboratory at Dalhousie College by Mr. W. A. Macdonald.

The experiments had been intended originally to deal with rigidity only, but it had been found possible to apply some of the observations to the determination of Young's modulus as well.

The composition of the specimen of india-rubber used was not known. It was in the form of a cylindrical cord, and was fairly soft in texture, and grey in colour, a freshly cut surface having a mottled appearance. It had been obtained from Messrs. Thornton & Co., Edinburgh, and was both very true and very uniform in its circular cross-section.

The method employed for determining the rigidity under tension was the method of oscillation. It was necessary therefore to fix the upper end firmly, and to attach a weight holder firmly to the lower end. As the problem had been assigned to Mr. Macdonald as a class exercise merely, and no appropriate gear for the attachment of the ends was immediately available, he had to be contented with a makeshift method. He drew the ends of the cord through pieces of glass tubing, previously coated internally with soft sealing wax, of considerably smaller diameter than the cord, and then gently heated the tubes until the wax melted. The tube at the upper end was fixed to a bracket, that at the lower end carried a cork disc, which served as a weight holder. To reduce the error due to lack of uniformity in the diameter of the cord near the ends, produced by the pressure of the tubes, the cord selected for use was a long one. Except in so far as the heating may have changed the physical properties of the cord near the lower end, the arrangement was satisfactory enough for the comparatively small extensions for which it was intended. But for the greater extensions, to which the earlier results made it appear desirable to proceed, it was not suitable; for under considerable stress the wax near the ends of the glass tubes gave way, and the space thus left in the ends of the tubes had to be packed to make it certain that the portion of the cord actually subjected to tension and torsion was the portion outside the tubes. The observations under the greater stresses are thus considerably less trustworthy than the others.

* From the *Proceedings of the Nova Scotian Institute of Science*, Vol. x., Session 1898-99.

The weights used were square plates of sheet-lead with an edge of 4 inches, having a small circular portion cut from the centre, and a slit from the centre to the edge to admit of their being placed on the holder. Their moment of inertia could therefore readily be calculated. The length of the cord was measured by means of a beam compass, reading to ·01 inch, and its diameter by a micrometer gauge reading to ·001 inch. The time of oscillation was determined by means of a stop-watch reading to 0·2 second. The observations given below were in all cases means of several individual observations—the length and radius of five, and the times of oscillation, of ten. No special effort was made to keep the cord at constant temperature; but the temperature of the laboratory varied but little.

The course of the observations was determined by Mr. Macdonald's available time rather than by the fitness of things. He kept the cord stretched slightly throughout the whole series by 482 grm., and from time to time he would apply additional weights, make the requisite observations, and then remove such additional weights, the observations requiring perhaps a couple of hours. The dates of the observations are given in the table below. Unfortunately the length of the cord under its permanent stress was not in all cases, and its diameter was in no case determined immediately before the application of the additional weights, such observations not being necessary for the purpose originally in hand.

The following table gives the results of the observations and the calculated values of the rigidity. The observations have been reduced to C.G.S. units, and the rigidities expressed in absolute units of that system. The rigidities were calculated from the formula:—

$$n = \frac{8\pi l \mathrm{I}}{r^4 t^2},$$

where n is the rigidity, l the length, and r the radius, of the cord, I the moment of inertia of the lead plates, and t the time of a complete oscillation. In finding the moment of inertia the weight-holder of cork and glass was neglected, as also the small circular apertures in the lead plates. The volume of the cord is given in the table also.

Date.	Temperature, (° C.)	Length, (cm.)	Radius, (cm.)	Weight appended (grm.)	Time of oscilln. (sec.)	Volume of cord (c.c.)	Rigidity, (abs. C.G.S. units). $10^{10} \times$
			First Series.				
Mar.							
16	15·6	90·68	...	482	...	...	...
21	18·1	90·98	0·356	482	10·80	36·03	10·18
21	...	96·60	·343	735	16·00	35·69	8·68
22	17·5	91·24	...	482	...	...	...
22	17·6	103·99	·335	951	20·04	36·73	8·69
23	18·7	91·51	...	482	...	...	...
23	18·9	113·92	·323	1,222	25·32	37·25	8·67
28	18·6	92·35	...	482	...	...	...
28	18·6	123·21	307	1,467	29·76	36·57	9·89
Apr.							
4	18·8	137·41	·293	1,714	35·88	37·16	10·68
5	19·3	138·38	·293	1,714	36·36	37·42	10·48
6	17·7	150·37	·279	1,956	40·80	36·88	12·54
			Second Series.				
13	17·0	95·65	·345	482	12·22	35·86	9·38
13	17·4	102·16	·337	735	18·44	36·36	7·44
13	17·5	110·31	·324	981	23·80	36·35	7·51
13	18·0	121·13	·312	1,222	29·26	37·15	7·85
20	...	130·97	·301	1,467	33·64	37·28	8·95
20	...	141·83	·290	1,714	38·48	37·36	10·10
20	...	151·99	·282	1,956	42·30	37·96	11·37

The first series of observations showed that the rigidity, as determined, at first diminished with tension, then reached a minimum value, and finally increased, as the cord was more and more stretched,—an interesting result if it should be substantiated. Hence a second series of observations was made with the same cord and the same arrangements as the first. This series had to be made somewhat hurriedly, as will be seen by the dates of the individual experiments, but the experiments were made with the same care as those of the first series. It will be seen from the above table that (1) the treatment to which the cord had been subjected in the first series had diminished its rigidity, the values being smaller throughout than in the first series, and (2) that the initial diminution of rigidity with increase of tension, its final increment with tension, and the occurrence of a minimum point are as marked in the second series as in the first.

To find out if the occurrence of the minimum point was due to the defective character of the attachments at the ends of the cord, Mr. Macdonald made a number of observations with new modes of attachment. These consisted of brass tubes in one end of which three longitudinal cuts had been made, the ends of the three strips thus formed being bent inwards and provided with teeth. The ends of the cord having been passed into these tubes, the strips were firmly bound to the cord by means of wire. Unfortunately, Mr. Macdonald had not sufficient time to make more than rough observations with the new arrangement. Such observations as he was able to make seemed to show that the minimum point had disappeared. Whether its disappearance was due to the more satisfactory attachments, the passing away of the heating effect or the fatigue of the cord, Mr. Macdonald hopes to determine by further experiments.

The above values of the rigidity agree fairly well with Mallock's* determinations, Mallock having found that the rigidity of what he calls "soft grey" india-rubber, determined dynamically, ranged from 5·52 to 8·76, if expressed as in the above table, and that for "hard grey" rubber it ranged from 10·77 to 13·94. Mr. Macdonald's rubber could not be designated as either soft or hard, and his values are intermediate between Mallock's for the soft and the hard specimens.

The volume of the cord underwent very little change during either the first or the second series. In both series, however, there is an unmistakable though small increase of volume with stretching; but whether it was due to the stretching or to the series of oscillations to which the cord had been subjected does not, of course, appear.

Mr. Macdonald did not intend, at the outset, to make any determinations of Young's modulus, but his observations may be used for two purposes, viz., to determine (1) how the value of this modulus for a cord under a constant original stress varies with the magnitude of the increment of stress to which it is subjected, and (2) how the value of the modulus for a cord under different original stresses, and elongated by approximately equal increments of stress, varies with the magnitude of the original stress. In the determinations given below, Young's modulus has been taken to be the increment of tensile stress divided by the corresponding increment of length per unit of the length immediately before the stress was increased.

1. The observations requisite for the first purpose were made only in a few cases, and even in those cases in calculating the increment of tensile stress it is necessary to assume (the requisite measurements not having been made) that the radius of the cord would not appreciably vary with the small variations of length under the permanent load—an assumption which is doubtless permissible. The following table gives the results:—

Original stress (grms. per sq. cm.)	Additional stress (grms. per sq. cm.)	Elongation per unit length.	Young's modulus (abs. C.G.S. units). $10^6 \times$.
1,354	789	0618	12 53
1,354	1,574	·1397	11 05
1,354	2,529	·2449	9 73
1,354	3,424	·3342	10 05

These determinations would thus seem to show that for the smaller additional stresses to which the cord was subjected, the value of Young's modulus diminished as the additional stress increased, that for the larger additional stresses it increased with the additional stress, and that there was a certain additional stress for which Young's modulus had a minimum value—this additional stress being of such a magnitude as to produce an elongation of about 0·25. This result is in agreement, qualitatively, with Mallock's observations, which showed that Young's modulus, statically determined, "diminishes with the extension until the stretched length is about 3/2 times the natural length." As Mallock's rubber no doubt differed in degree of vulcanisation from Mr. Macdonald's, and as he used a different initial stress, it is not surprising that the elongations giving a minimum value for Young's modulus should be 0·25 in the one case and 0·5 in the other.

Mallock's mean value of Young's modulus, when expressed in absolute C.G.S. units, was $8·56 \times 10^6$ for soft grey india-rubber, and $34·16 \times 10^6$ for hard grey rubber. As in the case of the rigidity, Mr. Macdonald's values are intermediate, being nearer Mallock's values for the soft than for the hard specimen.

2. The following table contains the determinations made for the second purpose mentioned above:—

Original stress (grms. per sq. cm.)	Additional stress (grms. per sq. cm.)	Elongation per unit length.	Young's modulus (abs. C.G.S. units.) $10^6 \times$
	First Series.		
1,354	789	·0618	12·53
2,143	785	·0765	10·06
2,928	855	·0955	8 78
3,783	995	·0816	11 97
4,778	1,072	·1152	9·13
5,850	1,161	·0943	12 08
	Second Series.		
1,397	784	·0681	11·30
2,181	847	·0798	10·42
3,128	889	0981	8 89
3 917	957	·0812	11·55
4 874	1,035	0829	12 26
5,910	1 026	·0716	14 05

It will be seen that in both series of observations the values of the modulus are large at the outset, diminish in value as the original stress is increased, reach a minimum value and thereafter increase with the original stress. The irregularity of the fourth and fifth determinations in the first series, is obviously due to the unusually long intervals of time which, as the first table, p. 30, shows, intervened between the two pairs of observations on which they are based. The variation of Young's modulus with initial stress, the additional stress being roughly constant, would thus appear to be similar to that which was shown above to hold with respect to additional stress when initial stress is constant.

* *Proceedings Royal Society*, London, 46, 233, 1889.

It should be noted, with respect to all the above determinations of Young's modulus that the values found apply to the state of the cord immediately after the application of the additional stress, and in addition that the cord was subjected to torsion after each observation of length.

THE MECHANICAL EQUIPMENT OF A LARGE RAILWAY STATION.

I.

A recent paper presented to the American Society of Mechanical Engineers contains a description of the mechanical equipment of the new south station at Boston, U.S.A.;* it is of interest as being illustrative of the tendency to place large contracts with well-known firms of contractors without submitting the work to tender. This is a practice that was once much more common in England than it is to-day. The old manufacturing firms of the North would as soon have changed their doctor or lawyer as have gone to a fresh firm for a boiler or an engine. In the equipment of the new Boston station the Westinghouse Company were called in as both advisers and contractors, and designed the whole scheme. The new station is a Union station for all lines entering Boston from the south. These are the more important of the lines, and the station is said to be the largest in the world, but it appears to deal with about 750 trains daily, or about the same number, we believe, as Waterloo. Boston claims to be the second city of America, as regards being a large centre of population, on a basis of a 50-mile radius. It thus contains nearly 2,400,000 for a population, or about one-third that centred round Manchester at the same radius. This is hardly a proper comparison, as Manchester thus contains its equally large neighbour, Liverpool. Probably Glasgow on a similar radius more nearly parallels Boston, both being seaports.

About 50 million passengers are to be dealt with annually, so that the station is to do a large business; but there seems to have been an enormous amount of preliminary talk and deliberation before the work was commenced, and everything was well thought out, and the station put into work in midwinter without a hitch. This does not tell against the principle of throwing the responsibility of both design and construction on the same shoulders; as the author of the paper states, mechanical engineers are, perhaps, more than either civil engineers or architects, the same in characteristic, whether consulting or constructive. The undertaking included switch and signal work, ice and refrigerating work, air brake testing outfit, and baggage handling. It was necessary, in order to accommodate the whole service within the area available, to place some of the 28 tanks below the main floor, and to waterproof this cellar portion to prevent tidal influx. The lower track forms a huge loop round which suburban trains circle and leave the station at the same end as that they enter by.

Baggage is dealt with by nine trucking platforms, and an underground passage was designed to allow the baggage trucks to cross beneath the tracks. The switch and signal work is operated by electro-pneumatic means, and the large use of electricity demanded a central power distribution and generating station for power and light, lifts, heating and air brake testing, as well as the multifarious duties of water supply, fire protection, and kitchens.

There is thus one central power station supplying electric current on a uniform system, a simple water distribution and air and ammonia compression. The power house for all purposes measures 460 feet by 40 feet. There are 10 boilers of plain horizontal return tube type, each containing 130 tubes 3 inches diameter × 18 feet long. They are 72 inches diameter, and work at 145 lbs. pressure, and are fired by Roney mechanical stokers, a type of stoker well adapted to underfired boilers. In underfiring these high pressure boilers a practice is followed that has never been discarded in America, though here it is looked on askance. The question arises, Is this manner of firing one that might not again be practised with modern steel boilers if supplied with good water? It is still held to be safe in America, where boiler plates are no better than here. Coals can be dumped from a coal train upon a deck level with the hoppers of the stokers. A pair of economisers are employed capable of being arranged in series or parallel in the flues. Draught is furnished by two large slow running fans with vertical discharge driven by horizontal engines, one fan being spare. The regulation of the draught is automatically performed by steam pressure. The stack is 11 feet diameter, and stands a few feet only above the roof. Feed pumps are compounded on their steam ends, and exhaust to auxiliary feed heaters. The steam pipes have welded steel flanges, and expansion is provided for by large radius bends. The engine power consists of four compound Westinghouse engines of 1,500 I.H.P. total direct coupled to four 225-KW. generators. Deane independent condensers are used, a curious American system of using direct acting steam pumps to drive the condensing side of an engine, whereby by using a pound of steam in driving air pumps about as much is saved in the main engines. All hot water feed pipes are of brass.

The important feature of the whole plant is the electro-pneumatic interlocking switch and signal apparatus. This apparatus would, if hand-worked, include about 360 levers, and, at 20 levers per man, would employ 18 men on duty at once for each 8 hours' day shift and 6 men at night. The pneumatic system can be worked by 3 men on each day shift and 2 at night. As the 42 mechanical men would receive $37,800 annually, and the 8 pneumatic men receive $7,200, the annual saving is about £6,000. Electricity is the controlling agent, and air compressed to 80 lbs. pressure does the work.

* Some illustrations of the equipment appeared in a previous article published in the Electrical Review, September 1st, 1899.

The system involves an air compressor and reservoir, pipe lines extend therefrom to the interlocked system of switches, a cylinder to operate each switch and signal; an electro-magnetic valve controls the air from the air main to each cylinder, and wires extend from these magnets to the interlocking machine in the tower, where the machine is so constructed as to apply electric current to the wires operating the magnets. The air supply is given by two 14 inches × 18 inches air compressors, each capable of compressing 382 feet of free air per minute. The maximum speed is 120 revolutions per minute, but over 30 revolutions are rarely called for, and the busiest time does not call for more than 100 cubic feet of free air; but large capacity is an important safeguard against breakdown, and renders possible rapid accumulation of pressure, should the pipes and reservoir have been depleted by a pipe rupture or other cause.

Current is taken from a set of Chloride accumulators of 300 ampere-hours capacity arranged in duplicate and charged by a rotary transformer driven by current from the main power house, which delivers to the batteries 20 amperes at 25 volts. The maximum output of the cells is 5 amperes for all purposes. Above the machine is a small model of the track with all switches on a black board. The model switches move in unison with those of the track itself.

All signals gravitate to danger position, and each requires a single-action cylinder to move it. These are 3 inches × 4 inches, and are thus powerful enough to lift 187 lbs. 1 foot. Switches have double-acting cylinders to operate them.

With 1,100,000 square feet of area to provide for, the incandescent lighting demands 650 H.P., the arc lighting 200 H.P., general motor service 320 H.P., and the baggage lifts and elevators 381 H.P., the maximum distance being 3,000 feet. The current for the switch and signal work and for synchronising clocks was a mere nothing. The three-wire system was desirable, thus enabling 110-volt lamps to be employed on the neutral with 220-volt motors on the outers, but it was thought to present disadvantages in the small size and large number of units necessary, and in place of it there were constructed three-wire generators, each capable of giving both 110 and 220-volt current at the same time.

The generators are multipolar, with 10 poles, compound wound, with fields vertically divided. Eighteen feeder circuits were found necessary, some being of loop type. There are 48 motors, aggregating 698 H.P., the largest being 50 H.P. They are mostly 220-volt 4-pole machines, except for the elevators and ventilating fans.

(To be continued.)

MEAN PRESSURE INDICATOR.

An instrument for measuring mean pressures was described in a paper recently read by Prof. Ripper before the Institution of Mechanical Engineers. The instrument is interesting after one has found out from the paper what it really is. Under the head of description of the instrument there is absolutely no statement of the principle of action, and very little of any kind of description The only thing really described is the valve which admits steam to the instrument. This valve is illustrated by certain figures, and is described as the simplest form of instrument, whereas it no more represents the instrument than does the cock on the cylinder represent an ordinary indicator. After wading through Prof. Ripper's paper, the bulk of which appears to be a lengthy dissertation on the difference between the distance travelled by an engine piston and the distance moved through by the crank pins, so far as regards indicator diagrams taken on a time basis or a basis of equal piston movement intervals, we find that his instrument consists of a pressure gauge placed alternately in communication with both ends of the cylinder so as to register steam pressure, and another gauge similarly placed to show the exhaust side pressure. Between the valve which maintains the gauge in communication always with the steam side of the piston, or *vice versâ*, and the gauges themselves, there are two throttling cocks. These, it appears to us, are the real instrument rather than the particular rotating or oscillating valve, for by means of these throttling cocks the finger of the pressure gauge maintains practically a steady position which is claimed as the real mean pressure. The truth appears to be that, given sufficiently fine throttling through two cocks with a piece of pipe between them, the mean pressure in the cylinder will be shown by the gauge. The method is simply a repetition of the familiar method of steadying a gauge pointer by partially closing the tap leading to it, and is probably quite as reliable as claimed by Prof. Ripper if the suitable corrections are made which are necessary by reason of the fact that the mean pressure reading is, of course, on a time basis, whereas the pressure acts through a certain space and the piston travel is a flowing quantity ever increasing and decreasing.

Tests made on the experimental engine at the Sheffield Technical School show that the new instrument corresponds within about 4 per cent. with the ordinary indicator, and probably if every engine could be compared in this way, so as to get the "rate" of the new instrument, it might be used very successfully as a continuous indicator from which power could be at once read off. Also by means of a suitable slow moving integrating movement the instrument could be made to record energy like a watt-hour meter, showing at any time the number of units generated since last reading. The latter part of the paper deals with the trouble experienced from the water in the pressure gauge syphons. It seems to us that if it be worth while to use this mean pressure instrument, it should be worth while to use glycerine in the syphon tube, which is practically unaffected, and would certainly give no trouble from ebullition, such as described, or even oil would serve and would remain quiescent in the syphon. Such a paper as this should contain early in its course a plain and simple description of the instrument it purports to describe. The paper before us, though in itself instructive and valuable, would have been more so if better put together.

There are two dials or pressure gauges, one for forward and one for back pressure, and, obviously, a pair of rapidly reversing valves are part of the apparatus so as to place the instruments in communication alternately with opposite ends of the cylinder. The mean pressure is conveyed to the instrument by allowing the cylinder pressures to be communicated through very narrow passages capable of being throttled down to such a point that the finger of the dial remains steady. The action of the instrument thus depends upon the fact that the strength of the gauge spring is insufficient to force back the working fluid sufficiently rapidly to allow perceptible motion of the finger. Nor can the higher steam pressure effect the reverse movement, and the result is the finger shows the compromise between the two endeavours, and this is the mean pressure, or so near to it as to be as accurately so as the pressures found from the ordinary indicator card. In the present instrument the rotating alternating valves have been replaced by a pair of self-acting valves, one a double-seated valve, the other a globe valve. These valves, between them, effect the desired change of pressure, but are obviously unsuited where the compression is considerable or the expansion long continued. As the instrument is more perfected doubtless it will come into considerable use.

Obviously, the instrument endeavours to show the pressure which acts upon it during given intervals of time. Time is necessarily a determining factor in the result of keen throttling of the flow of a fluid. But the pressure on a piston at the commencement or early part of the stroke, say during the first 30° of crank movement, represents a much less piston movement than the third or fourth arcs of 30° when the crank is approaching to, and receding from, the approximately mid-cylinder position of the piston. Probably the errors thus introduced are so closely balanced by the similar errors introduced by the same action at the opposite end of the stroke as to be negligible. There appears a field for this instrument. The recent experiments of Prof. Weighton would have been much simplified had he had such an instrument to at once show what were the mean cylinder pressures for every variation of cut-off. A whole series of tests could be run in a very short time, for the instrument would point out the maximum power cut-off at once, although the maximum economy cut-off would still be indeterminable so simply. There is now only wanted an instrument to show variations of water consumption on the same principle, whereby at once the water or steam consumption of an engine can be read off at once.

It is not essential that such instruments should be accurate. What is essential is that their rating shall be accurate. A ship's chronometer is not wanted to keep correct time, but it is wanted to vary from the truth an equal amount every hour. It is easy to make a known correction. So with these steam engine instruments when used on scientific practical tests. They need not be absolute, but they must have a regular variation, or must always show a more forward movement when the occasion demands it, and *vice versâ*. They must not show at one time a gaining rate and at another time a losing rate.

UTILISATION OF WASTE HEAT.

Writing on this subject to the *Engineer*, Mr. Rainey, who is more or less biassed in favour of fan draught, presents a few figures to support his views. The statement he makes is, that to burn 20 lbs. per square foot of grate the chimney temperature on land must be 650° F., while at sea, where the total funnel height is not often more than 40 to 50 feet—it is 120 feet in the *Scot*—the temperature must be 700° to 800°. We do not agree with these figures; we consider they are rather overstated. We have known it done, and we believe it is common practice in Lancashire to-day, that 20 lbs. of coal are burned per square foot of grate per hour where economisers are used, and the chimney temperature is a long way less than 600°.

We quite agree that fan draught may be economical, but we do not endorse Mr. Rainey's figures to the full extent. Assuming that 1 lb. of coal has a calorific capacity of 15,000 B.T.U., the chimney loss for temperatures of 500°, 600°, 700° and 800°, is given respectively as 17, 21, 23·6 and 28 per cent. These figures are not far wrong, being based evidently on a furnace temperature of about 2,600° F.

To burn at his standard rate of 20 lbs., using 20 lbs. of air per pound of fuel, Mr. Rainey states that the ash-pit draught must be about ⅜ inch to ½ inch, but is he correct when he claims that to secure this, the water gauge at the chimney base will be 1·7 inches, equal to a velocity of 5,168 feet per minute? On this point, however, the author is stating figures that are more unfavourable to his arguments than is really the case. To give the gases this velocity will require 2,500 to 3,110 foot-pounds of energy, as compared with the fully 2,000,000 foot-pounds used up by a chimney to the same effect when the chimney temperature is 500°; obviously, however, the 2,500 foot-pounds of energy required by a fan draught may be multiplied 20 times to find the calorific capacity of the coal, whence the fan ultimately derives its energy. This swells the fan energy to 50,000 or 60,000 or say to 100,000 or 120,000, if the inefficiency of the fan be taken into account.

If we assume that only half the chimney waste is saved, there will still be one million heat units saved to set against the fuel used to drive the fan—a two-fold saving that may be further increased if suitable means are employed to more completely absorb the heat from the flue gases.

The mechanical efficiency of a fan and engine combined is given at 60 per cent., the fan alone being credited with 70 per cent. Small plants are rated at 50 per cent. efficiency and on this basis 6,220 foot-pounds of energy are assumed to be needed to give the necessary draught velocity. This is, of course, too favourable a way of putting the case for fan draught, for it ignores the thermo-dynamic efficiency of the steam engine that drives the fan and generally the plant efficiency, excepting only, as just stated, the mechanical efficiency of fan and engine.

The following table is given as taken from actual plants, in order to show the results possible with water heaters:—

——	1	2	3	4	5	6	7	8	9
Gases entering heater	610	505	550	522	505	465	490	495	541
„ leaving „	340	212	205	320	330	250	290	190	255
Water entering heater	110	84	185	155	190	180	175	155	130
„ „ leaving „	287	276	305	300	300	295	280	320	311
Gain in temperature	167	192	120	145	110	115	105	165	181
Fuel saving per cent.	16·7	19·2	12·0	14·5	11·0	11·5	10·5	16·5	18·1

In each case a first heating was effected by the condenser.

The cost of putting in and running a fan draught is said to be 60 to 70 per cent. of that of a chimney. We presume first cost and interest of the chimney are put against first cost, interest and power consumption of the fan. A case is cited where a fan for 6,000 H.P. is run for 0·6 per cent., or say for 36 H.P. If this only effected a saving of 5 per cent. it would still be most satisfactory, but we see no reason why in good designs at least 10 to 15 per cent. of fuel should not be economised, though it should not be forgotten that to do this, there must be an additional expenditure on economisers.

THE PRODUCTION OF LIGHT BY ELECTRICITY AND GAS.

By ED. C. DE SEGUNDO, A.M.Inst.C.E.

(*Concluded from page* 638.)

When considering the probability of electric energy being supplied at a cheaper rate, it must not be forgotten that in the case of electric light undertakings, a proper allowance has to be made by the undertakers for interest and redemption of capital, and this is a very appreciable amount, being about 15 per cent. of the total cost of the light. In course of time this item will be wiped off and need not be taken into account in calculating the price at which electrical energy can be sold by a company or local authority. There is another point of great importance in connection with arc lighting, the candle-power emitted by the arc lamp does not deteriorate with age, nor is it affected by winds and storms. Now, the incandescent gas is very appreciably affected by wind and storms, in fact, it is not an uncommon experience to find it necessary to renew a considerable percentage of mantles after a storm. The cost of electrical energy for public lighting should decrease in the future; first, because the item for interest and redemption will fall away; and, secondly, because the labour costs will decrease as the use of arc lighting spreads.

It is easily seen that the supply of electrical energy to the public can be made cheaper if either the cost of production is reduced, or if the efficiency of the means employed for converting electrical energy into light is increased.

With regard to the first alternative it is usually assumed that the cost of production of electrical energy is made up of the following items:—

Fuel.
Oil, waste, and water.
Labour and superintendence.
Maintenance, depreciation, and repairs.
Factory rent, rates and taxes.
Clerical assistance at factory.
General stores.

These are no doubt, strictly speaking, the chief sources of outlay in the process of generating and distributing electric energy with which the engineer concerns himself. But the directors of an electric supply company have to take into account among other items a further and more serious source of possible loss, namely, that under the conditions of the provisional orders in virtue of which the supply companies are allowed to come into existence, it is absolutely imperative that the company "make hay while the sun shines," as otherwise after the lapse of the prescribed number of years the local authority within whose power it may be to acquire the undertaking may, and probably will, exercise its right to purchase the company's plant, machinery and business on terms which will not take into account any capital expenditure which the company may during its life have incurred through mistakes, breakdowns, or accidents or misfortune of any kind. The general terms upon which a local authority may acquire the undertaking of an electric lighting company are known to most of us, and fully justify a company in making as large a profit as may be deemed desirable. The prices charged by supply companies working under provisional orders are therefore not necessarily a criterion of what can actually be done in the way of cheap electricity.

A glance at the results obtained by a local authority who have themselves undertaken the public supply of electrical energy without the intermediate private company, will show that the difference in the price at which electrical energy can be profitably sold in these circumstances is very appreciably lower than that charged by any public supply company. In 1892, that is eight years ago, the Bradford Corporation were able to produce electrical energy at a total cost of 4·04d. per unit sold, including depreciation and proportion of redemption fund, the cost, without depreciation or redemption, being 1·95d. per unit sold. The cost for 1898 was 1·43d. per unit sold, without redemption or depreciation, and this will, no doubt, be further reduced as time goes on.

It may be argued that at Bradford the absence of any restrictions as regards smoke consumption and the proximity of coal pits place the economic production of electricity in a more advantageous position than in other towns; this is true, but the difference in the cost attributable to the use of more expensive coal is not so great as might be imagined at first sight, ½d. per unit sold would be an ample allowance for this.

In connection with the question of the reduction of the cost of production, I feel very strongly that any new company starting to supply a district with electrical energy should not ignore the many important advantages of gas power. It has been demonstrated beyond doubt or cavil in numberless instances in England, on the Continent, and in America, that 1 I.H.P.-hour can be produced with a consumption of not more than 1 lb. of fuel in a Dowson (or other equally efficient) power gas generator, and the only objection brought against the gas engine by authorities on central station equipment, namely, that the gas engine is not sufficiently steady in speed, has now been overcome by the improvement in the arrangement of the cylinders of gas engines specially designed for driving dynamos. Further, the suggestion that large enough units cannot be obtained no longer holds. For some time 300 and 600 H.P. gas engines worked by producer and towns' gas have been in daily use with perfectly satisfactory results. The very great saving in labour and coal which can be effected by the use of gas engines instead of steam engines is at once apparent, and if the contention of at least one manufacturer of gas engines of large power can be borne out in every-day work, namely, that the engine of 650 I.H.P. will give 1 I.H.P.-hour with an expenditure of of 8,000 B.Th.U. corresponding to 0·75 lbs. of fuel in the generator, the reduction in the cost of production of electrical energy would be material; firstly, on account of the decreased fuel consumption; secondly, by the saving of labour; thirdly, owing to the saving in the stand-by losses in boilers inevitably incurred with power generation by steam.

As long ago as 1894, it was proved by actual work in practice that with gas engines the cost of electrical energy per unit delivered in even so small a quantity as 8,000 units per annum, was almost exactly 2d. per unit with gas at 3s. 3d. per 1,000 in the case of an installation of only 300 lamps. Assuming that the engine only consumed 17 cubic feet of gas per indicated horse-power per hour, and that 15,000 H.P.-hours per annum were produced, the saving by using Dowson gas instead of town gas, would be the difference between 15,000 × 17 = 255,000 cubic feet at 3s. 3d. per 1,000 or 9,945d., and about four times the number of cubic feet of Dowson gas at 3d. per 1,000 cubic feet or 3,060d., a saving of

6,885d. or a little over $\frac{7}{9}$ths of a penny per unit delivered, bringing the price down to $1\frac{3}{8}$d. per unit delivered.

With regard to the second point, namely, the possible increase of efficiency of the means adopted to convert electricity or gas into light, it is perhaps quite sufficient to merely state that according to Prof. Tyndall, the efficiency of the gas burner is 0·317 per cent., and that of the incandescent lamp about 5 per cent. There is certainly room for improvement in both.

There can be little doubt that it is becoming increasingly difficult to find any fixed basis upon which to establish a comparison between the relative cost of gas and electric lighting. If a scientific basis is assumed, such as the price at which a given C.P. of mean spherical illumination is obtained, we are at once confronted with a difficulty in applying such a standard in practice, namely, that such a comparison would bring into account the cheapest known forms of converting gas and electrical energy respectively into light, which at present are represented by the Welsbach burner and the electric arc lamp, the latter being not adapted for domestic lighting. From the discussion of these two forms of illumination for public lighting in the foregoing pages, it is clear that at the moment the arc light, with its 0·5 watt per candle is still to the fore, but should the "Kugel" light, or any other form of intensified gas lighting prove to be satisfactory and cheap in everyday work, it is quite possible that arc lighting may be beaten out of the field from the point of view of light for light only. But the cost of the material for producing the light, so to speak, is not the only cost to be taken into account, other expenses are incurred in maintenance and repairs which it is impossible to take in account properly in a theoretical consideration, and the extent of which can only be accurately arrived at after some extended experience in practical work.

The particular direction in which the man in the street is anxious to be informed is, whether it will cost him more to light his house by electricity with incandescent lamps than by gas. The intelligent householder does not look only at his gas bill when trying to make the comparison, but at his bill for decorations, and indirectly at his doctor's and chemist's bill. In these circumstances it is hopeless to arrive at any scientific or theoretical basis for comparison, but it will be seen from what has gone before that if electrical energy be obtainable by the public at anything like 3d. per unit, electric lighting by incandescent lamps will not cost more, light for light, than gas, and the indisputable advantages of electric lighting as compared with gas, for houses especially, would place electric lighting *hors concours* as far as gas is concerned in our homes. It is indeed a question whether the pecuniary and sentimental value attaching to the advantages of electric light do not, even at the price of 6d. per unit, more than counter-balance the extra cost, light for light. It is evident that a very large and an increasing number of people must think so, as the increasing outputs of our central electric generating stations testify.

The conclusions arrived at in the foregoing pages may be tabulated as follows:—

GAS.		ELECTRICITY.	Price at which electrical energy must be obtainable to cost the same amount, LIGHT FOR LIGHT as gas.
Conditions.	Cost per 1,000 candle-hours.	Conditions.	
Ordinary 5-foot burner giving 3 candles per cubic foot of gas consumed per hour. Gas at 3s. per thousand.	12d.	High efficiency incandescent lamps, 3 watts per candle throughout useful life.	3·25d. including renewals.
Ordinary 5-foot burner giving 2·4 candles per cubic foot of gas consumed per hour in every day work. Gas at 3s. per thousand.	15d.	Ordinary efficiency incandescent lamps, 4·5 watts per candle throughout useful life.	3·33d. including renewals.
Incandescent gas-light in domestic use. Life of mantle 400 hours on the average, 3·4 cubic feet of gas consumed per hour, average intensity of light, 40 C.P. Price of gas 3s. per thousand,	3·8d. including renewals.	Nernst lamp, 1½ watts per candle.	2·5d.

Incandescent Gas and Electric Arc for Outdoor Use.

INCANDESCENT GAS.—Remarks.	ELECTRIC ARC.—Remarks.
Intensity of light per cubic foot gas consumed diminishes owing to deterioration of mantle.	Intensity of light does not alter with age.
To maintain at proper efficiency great care has to be exercised to regulate the gas supply so that pressure varies as little as possible.	Not affected to any appreciable extent by such variations as may now occur in pressure of supply.
Burner must be protected from draughts which affect candle-power emitted.	Not affected by draughts.
Burners must be kept very clean so as not to have air supply restricted. Mantles liable to be broken by high winds.	Not affected by high winds.

We are led to the following conclusions:—

1. It is practically impossible to define a basis for comparison which shall be applicable to each and every form of gas and electric lighting.

2. If the ordinary 5-foot gas burner is compared with the 16-C.P. incandescent lamp for domestic lighting, then on the basis of light for light only gas at 3s. per 1,000 is equivalent to $3\frac{1}{4}$d. per Board of Trade unit, but that when the saving effected by the use of the electric light is taken into account, together with other material advantages, it is possible that electricity at 4d. per Board of Trade unit will, commercially, be equivalent to gas at 3s. per 1,000.

3. Lighting by incandescent gas is cheaper than by electric glow lamps.

4. Arc lighting is cheaper than any form of ordinary gas lighting or incandescent gas lighting.

5. Some forms of intensified gas incandescent lighting bid fair to compete with arc lighting, but their practical utility is not yet sufficiently demonstrated.

It will be interesting to compare the actual charges made by electric supply companies with the figures we have arrived at as the equivalents for gas lighting on the basis of candle-power only, and thus be able to form an idea as to the probability of electric light becoming as cheap as gas in the near future. It must be borne in mind that the undermentioned prices are fixed with due consideration to the disabilities under which electrical companies now labour and to which reference has already been made.

Locality.	Lighting authority.	Capacity of plant.	Price charged to private consumers per unit.
		KW.	
Aberdeen	Corporation	1,800	....
Belfast	,,	2,850	7d. first hour, 2d. after } For lighting. 4d. first hour, 1½d. after } For power.
Bradford	,,	2,769	4½d. for lighting. 2d. intermittent power. 1d. continuous ,,
Brighton	,,	4,210	7d. first hour, 1d. after } For lighting.
Edinburgh	,,	8,137	3½d. for lighting. 1½d. for power.
Liverpool	,,	7,090	4d. for lighting. 2d. and 1d. for power.
Oldham	,,	1,332	4d. and 2d. for lighting. 2½d. for street lighting.

The above are taken from the Electrical Review list of Electricity Works of the United Kingdom, and serve to show not only what is being done in the way of cheap electricity, but what may be looked forward to in this direction. We think a consideration of these figures will sufficiently indicate whether or not it is probable that before very long electrical energy will be supplied at a price that will compare favourably with the cost of gas lighting on the basis even of equivalent illumination.

Hull.—The electric tram system was extended to the Holderness Road on Tuesday last week. There was an official trial in the morning at which Major Yorke, R.E., Board of Trade inspector, was present. The Board of Trade inspector made several suggestions as to the rate of speed and other matters. It is intended to maintain a three minutes' service practically the whole of the day.

REVIEWS.

La Télégraphie sans Fils. Par Andre Broca. Paris: Gauthier-Villars, Imprimeur-Libraire. 1899.

Signalling through Space without Wires: the Work of Hertz and his Successors. By Oliver J. Lodge, F.R.S. London: The *Electrician* Printing and Publishing Company.

M. Broca's little manual is chiefly devoted to that kind of wireless telegraphy, in which the vehicle for transmitting the signal is electric waves. A great part of the treatise is taken up with a simple and popular explanation of the nature and mechanism of electric waves, in which the author, with great advantage, makes use of hydraulic analogies. This method is very good as far as it goes, but it still leaves a great deal to be understood, and is, consequently unsatisfactory to the man who wishes to know all about electric wave telegraphy. M. Broca's explanation of the function of the vertical conductors in wireless telegraphy seems to us wanting in completeness; he appears to consider that it plays the same part as Franklin's lightning conductor. He considers Franklin to be the true and first inventor of this important improvement in wireless telegraphy! M. Broca's book may, however, be recommended as a useful introductory treatise in the study of wireless telegraphy.

Prof. Lodge's book is a second edition of his Royal Institution lecture on the work of Hertz, with considerable additions on recent developments of signalling through space without wires. Dr. Lodge is a master of the theory of his subject, and has besides made considerable experimental contributions to wireless telegraphy. If his interesting and valuable little work has a fault, it is that he fails to do justice to some of his co-workers. In his chapter on "Coherer History," he discovers the nucleus of the coherer in Guitard's dust experiment of 1850. He passes on from that to Rayleigh's experiments on the effect of electrostatic induction on water jets. Hughes', Branly's and his own experiments are fully described, but no mention is made of the experiments of Mr. S. A. Varley, who described, in a paper read before the British Association in 1870, all the essential properties of the coherer. Mr. Varley, as long ago as 1866, applied what would now be called a carbon coherer as a lightning protector for telegraphic apparatus. That Varley thoroughly understood the action of the coherer may be seen from the following sentences, quoted from the above-mentioned paper: "The author, when experimenting with electric currents of varying degrees of tension, had observed the very great resistance which a loose mass of dust, composed even of conducting matter, will oppose to electric currents of moderate tension. With a tension of, say, 50 Daniell cells, no appreciable quantity will pass across the dust of blacklead or fine charcoal powder loosely arranged, even where the battery poles are approached very near to one another. If the tension be increased to, say, 200 or 300 cells, the particles arrange themselves by electrical attraction close to one another, making good electrical contact, and forming a channel or bridge through which the current freely passes." Varley's explanation of the action of the coherer appears absurdly simple compared with the elaborate explanations of its action which have been recently in vogue. The coherer is not directly sensitive to electric waves, but only to high tensions, whether induced in its electrodes by electric waves or by a constant E.M.F. from a battery. The decoherence of the powder by shaking was also mentioned by Varley in the paper cited.

Dr. Lodge appears to be equally unfair, if not ungenerous, in dealing with the important work done by Mr. Marconi in wireless telegraphy. He says there was no point of novelty in Mr. Marconi's apparatus when he took it in a sealed box to the Post Office, but "with the powerful aid of the Post Office Signor Marconi proceeded to develop his system of telegraphy on a large scale." Now, as a matter of fact, Marconi got no assistance from the Post Office, except what would be given to any inventor who wished to demonstrate his invention to the Post Office authorities. Dealing with the vertical conductor, which in Marconi's hands has made wireless telegraphy a practical success, Lodge says:—"This elevated plate, connected as it now is through a simple spark gap with the earth, is an obvious modification of a Hertz vibrator; for it may be regarded simply as a Hertz vibrator with its axis vertical, as Hertz often used it, and with its lower plate replaced by the earth, so as to double the available capacity." Obvious as this now is after the event, it did not occur to Dr. Lodge or any other of Marconi's predecessors in this field. When sending and receiving wires connected to the earth are used, Lodge thinks the resemblance to the Hertz vibrator no longer holds, and that the signals are not, in fact, transmitted by Hertzian waves but by electrostatic induction. The doctors evidently differ on this question.

Dr. Lodge's asides are usually not the least interesting and amusing part of his discourse. In this treatise on signalling without wires he manages to introduce some highly original criticisms on our Patent Laws. "In the present state of the law in this country, it appears to be necessary for a scientific man, whose investigations may have any practical bearing, to refrain from communicating his work to a scientific society, or publishing it in any journal, until he has registered it and paid a fee to the Government under the so-called Patent Law." In what country is this not the case? "This unfortunate system is well calculated to prevent scientific men in general from giving any attention to practical applications, and to deter them from an attempt to make their researches useful to the community." Why should this be so? The scientific man can get his invention protected by the Patent Law within a few days after he has sent in his specification, and is then at liberty to read his paper or publish it without forfeiting his rights. Dr. Lodge considers that in an ideal patent law the courts should take cognisance of discoveries or fundamental steps in an invention communicated to and officially dated by a responsible scientific society, and thereafter award to the discoverer such due and moderate recompense as shall seem appropriate when a great industry has arisen on the basis of that same discovery or fundamental invention. Such a patent law would be truly paternal legislation for the benefit of scientific men. Besides it assumes that patent rights should hold over an indefinite period. Would it be an advantage to substitute a number of centres of registration, for the single centre appointed by the present patent law, in order to save the scientific man a little trouble?

A great deal of interesting matter relating to wireless telegraphy will be found set forth in this little book in Dr. Lodge's own inimitable style. In some cases he appears to assume that his readers already know a great deal about it, and his explanations are consequently difficult to follow. A little more about the theory of electric waves by one so able to expound it would have been welcome. Some interesting appendices on the diselectrification of metals and other bodies by light are given, though their connection with signalling without wires is not obvious.

A Travers l'Electricité. By Georges Dary. Paris: Libraire Nony & Cie.

This imposing volume deals in a popular style with the whole range of the ever-increasing applications of electricity to meet the needs of men. The book is dedicated to the author's sons, and it would undoubtedly form very interesting reading to a youth with scientific tastes, though a little previous knowledge of electricity would be necessary. The book is profusely illustrated with apparatus and machinery, and with portraits of the leading lights and founders of the science.

The author lightens his exposition by introducing here and there electrical anecdotes which are, as a rule, exceedingly good and *à propos*. For instance, in discussing the question, What is electricity? he says that a schoolboy was once asked this question by an inspector, and failing to see the irony in the examiner's tone, he said: "I knew what it was yesterday, but to-day I have forgotten." The inspector bewailed the loss to mankind entailed by the defective memory of this youthful genius. How often will this chestnut appear in various guises? Another story about the Central Telegraph Office at St. Martin-le-Grand illustrates the contempt for distance engendered by familiarity in the mind of the telegraph clerk. Two telegraph clerks sat in separate rooms at St. Martin-le-

Grand; one had charge of a wire to Dover and the other of a wire to Paris through Havre. Clerk No. 1 discovered that he had left his pipe in No. 2's room. He asked his boy messenger to fetch his pipe for him, but the youth replied that it was no part of his duty to fetch pipes. No. 1 then called up Dover to put him in connection with Paris, and Paris to put him in connection with London by Havre. He now telegraphed to clerk No. 2 to send his boy with the pipe, as his own boy had refused to fetch it.

M. Dary's book contains chapters on What is electricity? atmospheric electricity; telegraphy; telephony; electric lighting; electric traction; electrotypy; electric navigation; the phonograph; electric horology; medical and surgical electricity; electricity on coasts; applications in naval warfare; military applications; applications to agriculture; applications to railways; domestic applications; miscellaneous applications; dangers of electricity; electric installations at the Paris Exhibition, 1900.

This list will show how extensive is the scope of M. Dary's volume. The information is remarkably accurate and up to date. Interesting biographies of the great discoverers of electric phenomena are given, and a much better appreciation than is usual with French authors of the work of foreign scientists and engineers is shown.

Where the range of subjects is so wide, a complete and exhaustive treatment of every subject is not to be expected. For instance, in treating of the origin of atmospheric electricity, M. Dary mentions evaporation as the principal agency, though it has been shown that evaporation has nothing to do with it, and makes no mention of Lenard's discovery of the generation of atmospheric electricity by waterfalls, nor of the discharge of electricity from the earth under the influence of sunlight. Planté's experiments are considered to give a complete explanation of the globular lightning, but this is by no means generally admitted; the more recent experiments of Righi, which have an important bearing on this subject, are not described.

It is rather surprising that M. Dary, in discussing the Nernst lamp, does not mention the earlier work of Jablochkoff and other interesting experiments carried out in this field in France.

Though such deficiencies as these occur here and there in the book, it is, on the whole, wonderfully complete, accurate, and up to date. The book would form an excellent guide to enable a non-technical visitor to the Paris Exhibition to get a good general grasp of the operation of the electrical machinery which, in bewildering variety, will be thrust upon his attention.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this Journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

6,101. "Improvements in and connected with micro-telephones." H. Oppenheimer. (Actien Gesellschaft Mix & Genest, Germany.) Dated April 2nd.

6,103. "Improvements in and relating to shade rings for use in connection with electrical and other lampholders." R. O'Brien. Dated April 2nd.

6,129. "Improvements in and connected with the production of paste carriers for collectors of electricity." R. von Graizel. Dated April 2nd.

6,141. "Improvements in magneto electric-generators for electric ignition purposes." A. F. Evans. Dated April 2nd.

6,153. "Improvements in and connected with electrically propelled motor vehicles." P. M. Justice. (Columbia and Electric Vehicle Company, United States.) Dated April 2nd. (Complete.)

6,188. "Improvements in armoured conduits for electric wires." J. B. Boutillier and W. B. Hunter. Dated April 3rd. (Complete.)

6,204. "Improvements in and appertaining to switches for electro-motors." H. C. Longsdon and S. Dale. Dated April 3rd.

6,209. "Improvements in electric bonds for street mains." G. Brewer. (A. A. Knudson, United States.) Dated April 3rd.

6,217. "An improved compound or material for bearings valves cells for storage batteries and similar purposes." P. H. Rosenbach. Dated April 3rd. (Complete.)

6,218. "Improvements in machines for electrically heating, welding, or working metals." C. L. Coffin. Dated April 3rd. (Complete.)

6,237. "Improved electrical gas igniting apparatus." J. Schwarzenbach. Dated April 3rd.

6,244. "Improvements in and apparatus for manufacturing plates for secondary electric batteries." L. David. Dated April 3rd.

6,261. "Improvements in electric switches and resistances." C. W. Atkinson. Dated April 3rd. (Complete.)

6,276. "Improvements in shade or globe holders for electric lights." J. G. Beevers. Dated April 4th.

6,296. "Improvements in electric furnaces." W. Borchers. Dated Apri 4th. (Complete.)

6,301. "Improvements in or connected with means for electrically igniting miners' safety lamps." W. Best. Dated April 4th.

6,312. "Improvements in, and in apparatus for the production of soda and chlorine by the electrolysis of chloride of sodium, the invention being also applicable for the production of potassium, sodium, aluminium or other metals of the same class." H. A. Cohu and E. Geisenberger. Dated April 4th.

6,317. "Improved automatic interrupter for overhead conducting wires and the like." W. P. Thompson. (E. Vittani, Italy.) Dated April 4th.

6,348. "A new and improved insulation for electrical wires." H. W. Webb. Dated April 5th.

6,385. "Improved methods of and apparatus for electrically separating the relatively volatile liquid component from the component of relatively fixed substances of composite liquids." J. F. Cooley. Dated April 5th. (Complete.)

6,405. "Improvements in switches for use with electric motors." W. H. Scott. Dated April 5th.

6,475. "A self-contained electric incandescent lamp and method of charging same." E. Harnett. Dated April 6th.

6,478. "Improvements in electro-magnetic mechanism." W. F. Jones. Dated April 6th. (Complete.)

6,479. "Improved accumulator plate." P. Ribbe. Dated April 6th. (Complete.)

6,488. "An improvement in apparatus for simultaneously actuating from one point the controlling switches of the several electrical motor cars of a train." Siemens Bros. & Co., Limited. (Siemens and Halske Actien Gesellschaft, Germany.) Dated April 6th. (Complete.)

6,496. "An improved automatic circuit breaker for use in connection with electric railways." J. Skopec and M. Orel. Dated April 6th.

6,499. "An electric meter depending on the electrolysis of mercury." R. A. Lehfeldt. Dated April 7th.

6,526. "Improvements in electric fire alarms." A. Munker. Dated April 7th. (Complete.)

6,528. "Improvements in or relating to electrolytic apparatus." J. C. Richardson and M. Whitwill. Dated April 7th.

6,530. "Improved capillary diaphragms for electrolytic apparatus." J. C. Richardson and M. Whitwill. Dated April 7th.

6,533. "Photomatic-telegraphy by electricity for transmitting pictorial particulars so as to reproduce from distant places facsimiles of direct portraitures automatically and speedily." F. M. Browne and R. Rowe. Dated April 7th.

6,540. "Improvements in or relating to electric railways with underground conductors." M. Stein. Dated April 7th. (Complete.)

6,548. "Improvements in brush-holders for dynamo machines or electric motors." H. B. Whitmore. Dated April 7th.

6,564. "Improvements in reflectors for electric incandescence lamps." R. Gaertner. Dated April 7th. (Complete.)

6,568. "Method for heating conductors of the second class." C. Raab. Dated April 7th.

6,569. "Improvements in or relating to the heating of conductors of the second-class." C. Raab. Dated April 7th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

18,450. "Improvements in cut-outs for electric lighting and other uses." A. Watson. Dated August 9th, 1897. To increase the length of the fusible wire, and thus reduce the risk of short-circuiting, the base is made with a circular or other shaped boss round a considerable portion of which the fusible wire passes. Recesses are formed in the boss to receive terminals to which the leads and fusible wire are secured. The wire may take a zig-zag course round the boss, the various lengths being separated by ribs on the boss, or a ledge may be formed on the boss to support the wire, the ledge or boss being in some cases grooved to receive the molten wire, if fused. 3 claims.

18,510. "Improvements in electrical current distributing fuse and switchboards." A. Watson. Dated August 10th, 1897. Each sub-current terminal is connected to the omnibus bar by contacts which are joined by a fusible wire and carried on an insulating holder. The contact is forked to embrace the terminal. The fuse carrier is shown partly sprung into place. 3 claims.

18,552. "Improvements in electric controllers for railway vehicles." S. Harris. Dated August 10th, 1897. Relates to a magnetic arc interrupter, and to an interlocking device for switches for railway vehicles. The drum of the main switch is preferably of magnetic material, and is surrounded by two coils suitably connected to the circuit and arranged to blow out any arc formed at the contact fingers. The interlocking device consists of two notched discs fitted on the spindles of the drums and sliding pistons carried on a support. The movements of the pistons are limited so that the discs can only turn when in certain relative positions. 13 claims.

18,644. "Improvements in electric telegraphy." O. J. Lodge and A. Muirhead. Dated August 11th, 1897. Relates to a system of signalling by Hertzian radiations in which the sending and receiving stations are provided with raised surface plates or are connected by bare or uninsulated wires; wires terminating in surface plates may be employed for part of the distance. Each station is equipped for transmitting and receiving, the line connection being changed by a switch which is preferably provided with earth and line contacts, and means for short circuiting the coherer when not in use. Single or double spark gaps may be employed. Several single-contact or other coherers may be arranged in parallel, the springs being brought together so as to be operated in sequence by a rotating cam. A coherer may be formed of filings placed on a partially-varnished plate situated over a magnet, and covered by a second spring-supported plate resting on the filings. The coherer may be arranged in one arm of a Wheatstone bridge, the second arm on the same side having a decohering electro-magnet. The other two arms of the bridge are formed of resistances, the battery being arranged across one axis while the receiver is across the other. The coherer may be arranged in series with the battery and receiver, these being shunted by a condenser, or the receiver may be in the secondary circuit of an induction coil, the primary of which is in series with the coherer and battery. When syntonised circuits are employed, the battery and receiver circuit is attached at the centre point so as not to affect the balance. Raised metal rods may be employed as radiators. 8 claims.

18,657. "Improvements in hand electrical firing apparatus, applicable for firing ordnance, grenades, mining charges, and the like." C. A. McEvoy. Dated August 11th, 1897. Relates to electric firing devices. An outer cylindrical case is closed at one end by a non-conducting disc carrying two terminal pieces, and at the other end by a cap. A dry battery is held down within the casing by the wooden ring so that one pole of the battery is always in connection through the spring with one terminal piece, while the other piece is connected by a metal plate to the casing. The circuit is closed by pressing the spring pusher inwards so as to cause the contact pin to press the contact on the end of the battery. 2 claims.

18,666. "A new material for the manufacture of electric conduits." C. Hannay and P. J. Thom. Dated August 12th, 1897. Conduits are formed of diatomaceous earth, such as Barbadoes earth or diatomite, mixed with paper or other pulp. The pulp is burnt out and the conduit impregnated with a solution of asphalt, &c. The conduit may be of any form and with any joint. 1 claim.

30,061. "Improvements in railway aero-electric brakes." C. Luyers. Dated December 18th, 1897. Relates to compressed-air brakes, and includes a compression pump, and an engineer's valve on the locomotive, and a distributing valve, a system of reservoirs and a brake cylinder on the vehicles. The rising of a diaphragm between two chambers causes an electric circuit to be closed and an electro-magnet on each vehicle opens a valve, thereby instantaneously emptying the train-pipe. The instantaneous release of the brakes is effected by turning a plug, thereby closing a circuit and causing a series of electro-magnets to open the exhaust valves on the brake cylinders. 9 claims.

30,923. "Improvements in electric elevators." H. H. Leigh. (F. J. Sprague.) Dated December 31st, 1897. Relates to electrically-actuated lifts. Two motors in series are employed. Each armature shaft is fitted with a pair of worms respectively. One pair of worms engages with two worm-wheels on the shaft of the winding drum, and the other pair of worms with two wheels on a shaft which is geared positively with the drum shaft by spur wheels. Synchronous working of the motors is thus ensured. One half of the drum is made with a right-hand groove, and the other with a left-hand groove. The two pairs of ropes leading to the cage are wound on the middle portion of the drum and two other pairs of ropes leading to the balance weight are coiled on the ends of the drum. Guide-pulleys for the ropes are mounted on a shaft threaded oppositely at its ends with a pitch equal to that of the grooves on the drum, and driven from the shaft by gears and an intermediate shaft which may be of any length. Shoe brakes fitted to drums on the armature shafts are normally applied by springs and kept out of action by solenoids acting through toggle levers. In the event of the lifting ropes becoming slack or mounting the ridges separating the grooves on the drum, a switch is automatically operated to stop the motors. To secure ready adjustment, the worm wheels and the spur wheels are bolted to a common flange. 8 claims.

1898.

7,788. "Electrical switch." F. Nunns. Dated April 1st, 1898. The contact bar is carried by a block of ebonite centrally pivoted and provided with an upwardly-projecting pin. The tumbler is slotted at the bottom and engages with the pin so rocking the block and making or breaking contact, a quick break being given by a spring. The contact-lever is divided and engages with slotted fixed contacts. The provisional specification states that the block is fixed to the cover and operates the contact-arm when the cover is rotated. 2 claims.

7,862. "New or improved combined globes and shades for incandescent electric lamps, and for electric arc lamps, and for facilitating the application of advertisements thereto." E. Bohm. Dated April 1st, 1898. A bulb for an incandescent lamp, or a globe for an arc, is blown with an enlarged upper part, which is more or less flattened to carry an advertisement or decorative design on its lower surface, and has its upper surface either silvered or made of opal, frosted, or coloured glass, to reflect light through an advertisement, and to serve as a shade. The body of the globe or bulb may be coloured or frosted to contrast or harmonise with the upper part. The silvering and the advertisement may be burnt on, or enamelled. 1 claim.

7,895. "An improved construction of fusible cut-out for electric circuits." T. Barton. Dated April 2nd, 1898. A block of insulating material is perforated to receive the shanks of plug or other terminals, which are secured by nuts. The fuse wire is clamped by the nuts. The block is formed with raised edges and ends to facilitate handling, and may be hinged to a support, such as a distribution board. 1 claim.

7,903. "Improvements in electric switches." J. M. D. Soule. Dated April 2nd, 1898. The contact plate fitted to be turned between the plates has oppositely-arranged projections, the former of which is connected to one end of an insulated spring, while the latter engages in a slot of the key. The porcelain base, contact plate, and key are relatively adjustable by means of the nuts of the square-headed bolt, and the cover is held between the shoulder of the key and a shoulder of the base. 4 claims.

7,961. "Improvements in electric switches." A. Wilson. Dated April 2nd, 1898. Switches for motors so arranged that the field-magnet circuit is completed before the armature circuit, and in the event of the field circuit breaking the main circuit is also broken. The apparatus may also be arranged to break the circuit should the current become excessive. The main contact arm is mounted loosely on the spindle on which the regulating arm is rigidly fixed. The arm carries a heel-piece adapted to engage a spring fixed on the arm and draw it into the position shown in full lines, so completing the field circuit. The arm is held in this position by a catch controlled by the magnet wound in series with the field. The arm can then be moved independently, a wedge depressing the spring and freeing the extension. On moving the arm back again a stud strikes a contact spring and short-circuits the magnet. The catch is thus released and the arm gives a quick break under the action of a spring. Sparking is thus prevented at the contact. The catch is similarly released should the field circuit be broken. An additional but reversed winding may be arranged in the magnet to neutralise the field winding in case of excessive current. The heel piece may be replaced by a suitable pin. 3 claims.

8,043. "Improvements in sockets or holders for incandescent electric lamps." J. W. Mackenzie. (Allgemeine Elektricitats-Gesellschaft.) Dated April 4th, 1898. Holders for incandescent lamps. A plunger-carrier consists of a block which has a lip turned in to retain the hollow plunger and the spring, and is secured in the insulating body by a screw. 2 claims.

8,054. "Improved means for fixing or fitting incandescent electric lamps into lanterns." J. Moores and H. O. Farrell. Dated April 5th, 1898. Relates to portable incandescent lamps, applicable for use on cycles or other vehicles. An incandescent lamp is provided with a cap having a flange and a central contact, so that it can be held against a flange in a holder by a central spring on a back piece, which is screwed into the holder. The back piece carries terminals. The flange may be the inner end of a reflector which carried a "lens" and is surrounded by a casing. 1 claim.

8,142. "Improvements in systems of electrical distribution." B. G. Lamme. Dated April 5th, 1898. (Date claimed under Patents, &c., Act, 1883, Sec. 103, September 18th, 1897, being date of application in United States.) Relates to means for automatically varying the electromotive force with the load in long-distance systems of transmission. Instead of a specially-constructed machine, a compound-wound dynamo is arranged in the circuit. The main generator supplies the circuits. The supplementary machine has its armature and series coil in series with the conductor, its shunt-coil being excited by a separate exciter with field coils in series. 2 claims.

8,179. "Improvements in and connected with means for electrically lighting railway carriages." E. Dick. Dated April 6th, 1898. Relates to a system of lighting for railway vehicles, in which each carriage is supplied with an accumulator, and in one of the carriages a dynamo is fitted and driven in the ordinary way from the axle. In connection with the dynamo is fitted (1) a switch for maintaining the direction of the current in the mains constant; (2) a switch for connecting up the dynamo or cutting it out in accordance with the tension of the current; (3) an automatic regulator for varying the strength of the field; (4) a resistance divided into two parts; and (5) switches for controlling the charging of the accumulator. On the armature being revolved a current is generated in the shunt coil of the armature, and the shaft of the switch No. (1) rocked to complete the circuits through the mercury cups, and to cut-out the resistance from the field circuit. The switch box has three windings and on the current reaching the required limit, the cores are operated and the main circuit completed through mercury cups. The regulator has four windows, and controls the resistance in accordance with the voltage required for the lamps, cells, &c. 8 claims.

8,222. "Improvements in clutches and brakes for arc electric lamps." G. Byng and A. E. Angold. Dated April 6th, 1898. Relates to arc lamps. Clutches and brakes, provided with india-rubber, leather, or other resilient operating surfaces, are arranged to compensate for wear of these substances. A clutch consists of a half tube, with a resilient lining held by two clamping-strips and screws, and pivoted between two plates which are connected together and are supported by a pivot on a link so that their weight holds the clutch against a carbon-carrying rod. This may be roughened by grooving. The plates have toothed upper edges, curved concentrically with the pivot. When the link is raised electro-magnetically, the teeth engage a stationary pawl, about which the plates then turn slightly so as to press the clutch forcibly against the rod, independently of wear of the clutch lining. A weight loose on the pivot is forked to engage a guide-rod to keep the clutch in position. The rod carries an upper guide for the rod. A brake consists of an oval block on the edge of which a strip of resilient material is clamped, to bear on the inside of the rim of a wheel. The block is pivoted to a toothed plate, which is pivoted to supporting and operating links, and is toothed to engage a pawl supported with limited pivotal movement on a support when the link is pressed upward; the plate then presses the resilient block against the inside of the rim. 2 claims.

8,273. "Improvements in and connected with electric bells." H. Oppenheimer. Dated April 7th 1898. A large-sized electric bell is rung by a weak current with slow strokes by an electromotor. The armature rotates between the poles of a permanent magnet and has a commutator and brushes through which the circuit is made. A pinion on the armature spindle drives a wheel carrying a snail which engages a roller on the tail of the hammer. The hammer is raised by the snail and strikes the bell in falling. To enable a signal to be given, consisting of a definite number of strokes, the circuit passes from one binding screw through a spring to the pivot, and thence through the snail, roller, hammer tail, and flexible connection to the second binding screw, the various parts being suitably insulated. This causes an interruption of the circuit at every stroke, due to the roller falling from the snail to the spring, resting on the pivot, and an indicator movement, such as a single stroke bell, buzzer, galvanometer, &c., is fixed at the operator's end to determine the number of strokes given. 4 claims.

8,274. "Improvements in and connected with electric bells." H. Oppenheimer. Dated April 7th, 1898. A bell for use in mines, chemical works, dye works, breweries, &c., has the armature and hammer mounted on opposite ends of a pin which is passed through the base, gas-tight and liquid-tight, either by grooving and packing the pin, or passing it through a gland stuffing-box. The cover is packed with a paraffined cord, &c., and the terminals are insulated in a cast-iron box filled with paraffin wax, and provided with a cover. The armature is held clear of the magnet by a spring, and is balanced by the hammer. The parts may, however, be arranged in any suitable way on the base. The bell is stated to be somewhat similar to that described in Specification, No. 7,492, A.D. 1892. 2 claims.

8,275. "Improvements in and connected with annunciators for telephone systems." H. Oppenheimer. (Action-Gesellschaft Mix & Genest.) Dated April 7th, 1898. The number plate of a telephone annunciator is arranged to be more easily visible to the operator by causing it to assume the inclined position when a call is made. The line circuit is connected to the magnet coil by a spring contact in the jack, and passes to earth. The armature is pivoted in an extension on a metal case. An extension on the armature bears on the heel of the annular number plate. The number is printed on the face and is normally hidden by a screen. A spring on the armature makes contact with the case. When a call is made, the armature is attracted and the number plate disclosed. The armature is held by a relay circuit from a battery, completed by a spring on the armature and a spring connected to the line circuit and coil by a wire, part of the current passing from the battery through the core to the armature and spring, and the other part through a ring, case and spring to the spring. The relay circuit is broken when the plug is inserted in the jack. A method of applying the invention to an ordinary annunciator is shown. 1 claim.

8,276. "Improvements in and connected with primary batteries." H. Oppenheimer. Dated April 7th, 1898. Relates to a battery of the Leclanché type in which the zinc electrode is provided along its upper edge with projecting strips by which it is suspended from the edge of a glass jar. The carbon rod is surrounded with the usual depolarising mixture and terminates below in an insulating mixture which rests on the bottom of the glass jar so that the zinc chloride which is deposited does not short circuit the battery. The cover is grooved in parts for the passage of the strips, to one of which is connected a copper strip. Two electrodes of this shape are simultaneously punched out of one plate of zinc. 4 claims.

8,277. "Improvements in and connected with keys or switches for multiple switchboards." H. Oppenheimer. (Actien Gesellschaft Mix & Genest.) Dated April 7th, 1898. Relates to switches for telephone switchboards. The three pairs of contact springs are secured to supports, and contact is made between by moving the end of the tumbler lever between the indents. The springs assist in giving a quick break between. In a modified construction insulating wedge shaped blocks are mounted on the springs and the tail piece moves between them. 3 claims.

8,278. "Improved fuse box for electric light cables." W. T. Henley's Telegraph Works Company, Limited, and D. S. Strang. Dated April 7th, 1898. The box is fitted so that armoured cables may enter through sockets. It is also provided with a divided water-tight lid. The socket for the concentric cable is divided into two parts, the former being cast with the box, and the latter being carried by a sliding plate having a tongue fitting in a groove. A socket shoulder to fit, is sweated on to the cable. The branches are similarly fitted with sockets which tightly fit in openings in the box. The conductors are connected by fuses and clamps as usual. The lid is made in two detachable parts, the former having a glazed opening and being secured by a nut to the latter. 2 claims.

8,318. "Improvements in electrodes and in the method employed for producing them." K. Krebs. Dated April 7th, 1898. The electrodes are formed by casting metals or alloys, or by moulding and baking plastic materials within moulds containing frames or cores. The cores and moulds are then subsequently destroyed, either entirely or partially by chemical agents, which either convert them into soluble compounds (which can afterwards be dissolved out or removed mechanically) or which disintegrate them so that they form spongy masses. Several forms of perforated metal plates or plates formed of baked earths containing metals are illustrated for use as cores, or woven wire or pleated metal strips may be used for the same purpose. The solution of the cores and moulds may take days or weeks to accomplish. 1 claim.

8,348. "Improvements in electrical measuring and indicating instruments." A. C. Heap. Dated April 7th, 1898. Relates to current meters for indicating at a station the difference of potential at the distant ends of the feeders in a supply system are arranged. The voltmeter may have either a movable coil, or a movable magnet for indicating or recording. In either case the winding is connected in parallel with a part of a high resistance, which is contained in the case of the instrument and connected between the near ends of the two feeders. The pressure indication thus obtained is reduced proportionally to the current in the feeders by including in circuit with the voltmeter winding a low resistance interposed in one feeder. This resistance is made of the same material and cross section as the feeder in order that their temperature and resistance may vary alike. The connection to the voltmeter may be adjustable, a scale being provided graduated either uniformly or to correspond to feeders of various resistances. A voltmeter for use on one side of a three-wire system is made with two windings acting additively on the indicating part, and one high resistance; a low resistance is interposed in each main. One winding is connected as described with one outer and in parallel with one end of the high resistance, and the other is connected similarly with the middle wire and the other end of the high resistance. 5 claims.

8,489. "Improvements relating to the electro-deposition of metal." H. W. Wright. Dated April 9th, 1898. Iron castings for lamps and stoves or other articles intended to be coated with brass, copper or other metal, are first galvanised or tinned, and after scratching are coated with the desired metal by the usual electroplating method. 2 claims.